AGRICULTURAL ENGINEERING

JANUARY • 1953

In this Issue . . .

The Engineering Challenge in Farm Structures

Performance Characteristics of a Corn Picker-Sheller

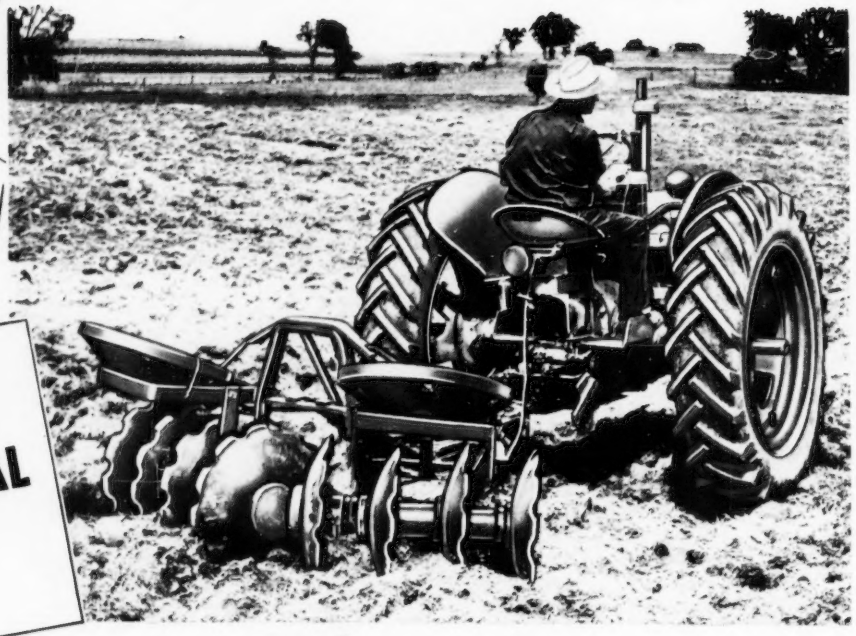
Engineering Factors in the Design of Nailed Trussed Rafters

A Study of Soil-Water Movement by Electroosmosis

Century of Progress in Farm Housing and Storage Structures

THE JOURNAL OF THE
AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

When Does 1=4?



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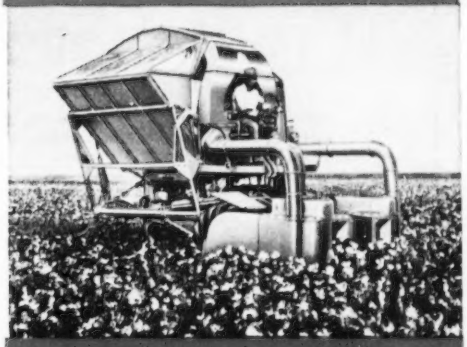

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AGRICULTURAL ENGINEERING

Established 1920

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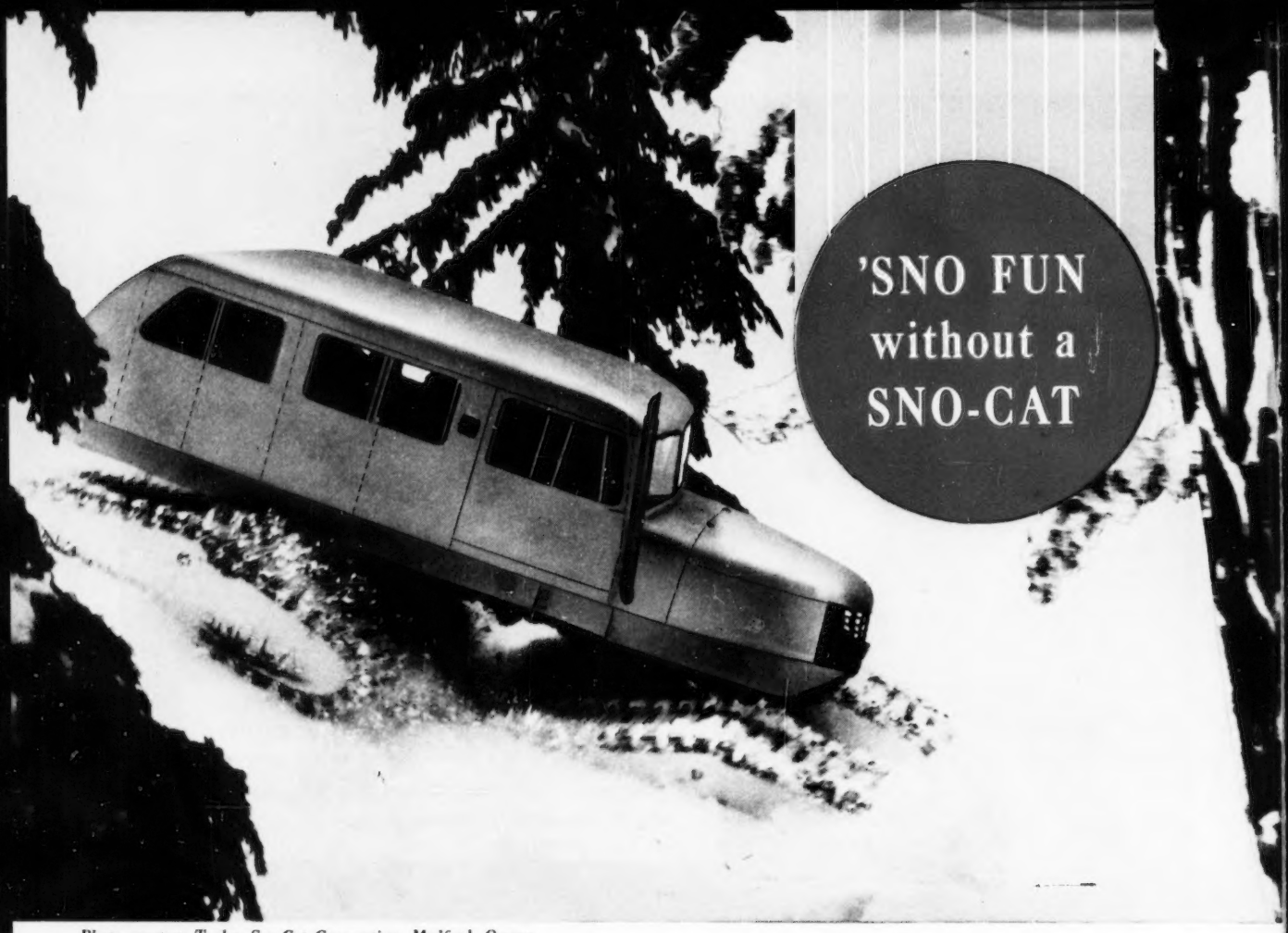

Photo courtesy Tucker Sno-Cat Corporation, Medford, Oregon

Snow, deep and powdery, on his favorite slope may be cause for rejoicing to the skier. But, to the men who must keep 60,000 volts of electricity crackling through ice-crusted lines in the high Sierras, to the men who must keep the lines of communication and transportation open to the West Coast . . . snow in any form spells possible trouble.

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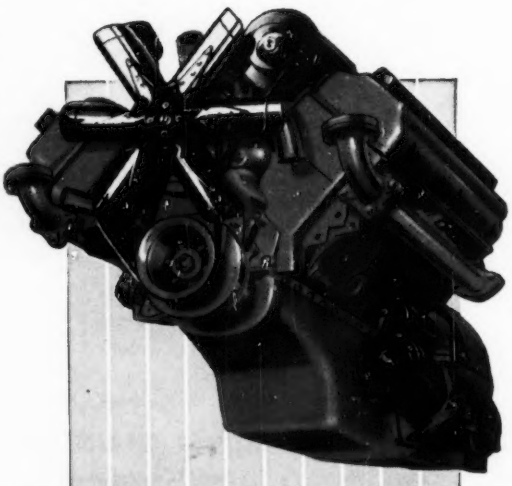

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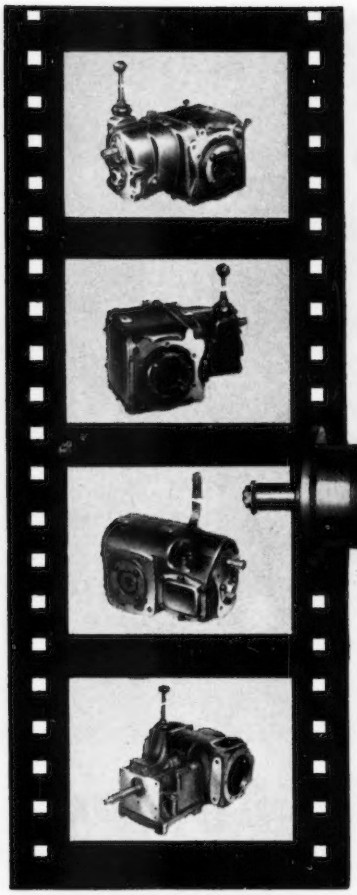

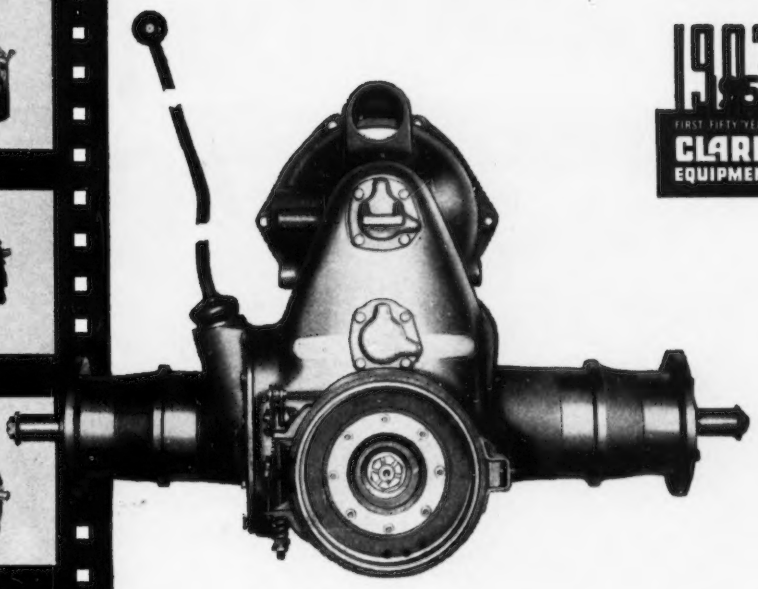

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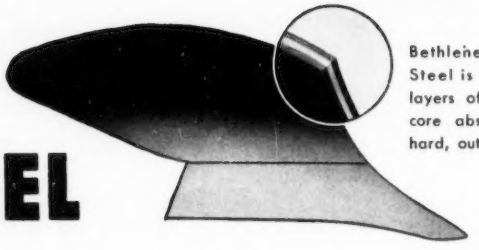

Bethlehem Soft-Center Steel is actually three layers of steel. Resilient core absorbs shocks on hard, outside layers.

When tillage tools are made from shapes cut and formed from Bethlehem Soft-Center Steel, you can count on their ability to take day-after-day punishment—even in rocky soils.

Here's why. Bethlehem Soft-Center Steel is more resilient than solid steel. The low-carbon core cushions the hard, outside layers from jarring bumps. In actual use, these top and bottom layers—made of tough, higher-carbon steel—develop a glass-smooth polish, enabling the tool to break the ground rapidly without excessive caking.

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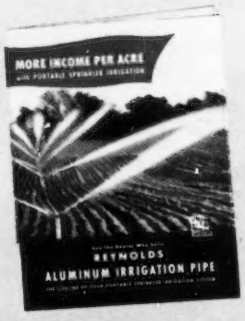

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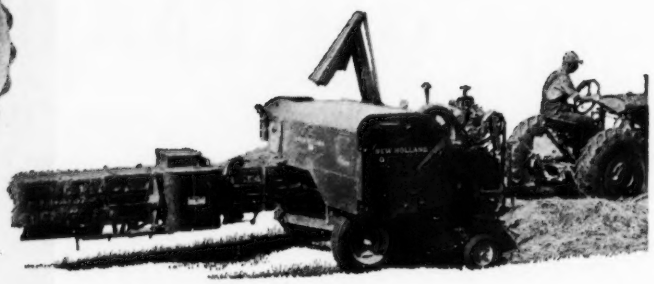

Here's how BCA engineering cooperation simplified production and cut costs for New Holland Machine Co.

New Holland no longer struggles with the problem of assembling a chain-tightener pulley *and* a bearing for hay balers. Today, they use an economical pulley—ball bearing combination in a single *package unit* designed by BCA for farm equipment use.

This revolutionary package unit represents an entirely new approach to the design of bearings for agricultural uses. It is far simpler and less costly than the pulley and bearing previously used for this application. Because it was designed to meet *all* farm service conditions, it eliminates the frequent field servicing formerly required.

This new BCA package unit is pre-lubricated and requires no further attention. It is sealed against dust and grit. The pulley is hardened to resist wear due to the chain. The rugged construction of this package unit assures excellent service under the most severe operating conditions.

This is merely one example of how BCA engineering cooperation and design assistance helps solve problems involving ball bearings. Perhaps we can make an important contribution to the solution of *your* bearing problems.

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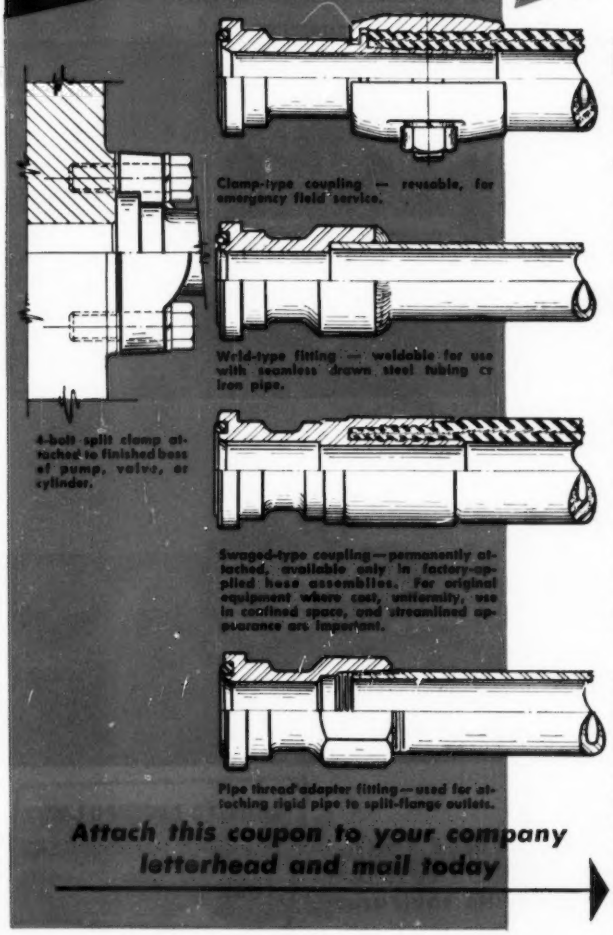
Stop Leaks... Eliminate Threaded Joints

in hydraulic hose assemblies

with this revolutionary, easy-to-use ANCHOR SPLIT-FLANGE CLAMP


Clamp-type coupling — reusable, for emergency field service.
Weld-type fitting — weldable for use with seamless drawn steel tubing or iron pipe.
4-bolt split clamp attached to finished boss of pump, valve, or cylinder.
Swaged-type coupling—permanently attached, available only in factory-applied hose assemblies. For original equipment where cost, uniformity, use in confined space, and streamlined appearance are important.
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on the Charles Schlevogt Farm, Ottawa, Illinois

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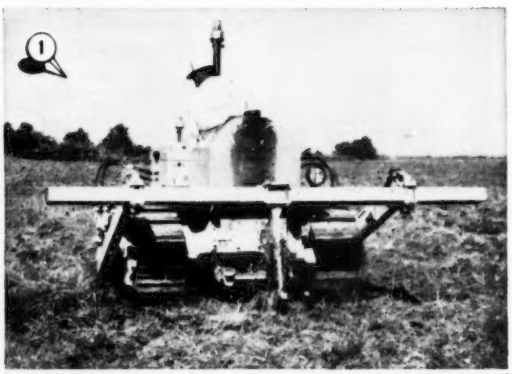
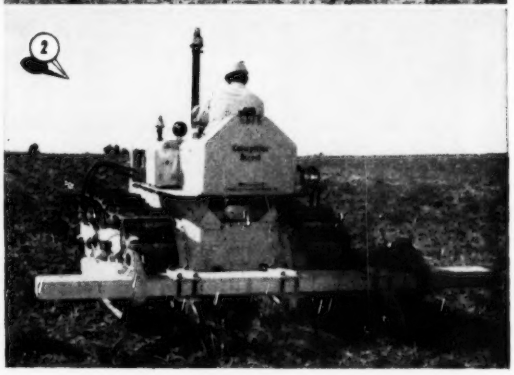


A Caterpillar Diesel Tractor with integrally mounted hydraulic Tool Bar and matched tools was the answer to pan problems. To shatter hardpan, a Subsoiler was mounted on the Tool Bar and set to subsoil about 24″ deep. This effectively loosened ground, created a means of stopping runoff, facilitated storing water in subsoil.



For destroying plow pan, the Tool Bar was equipped with chisels set for 14″-18″ penetration. The trash cover was not seriously disturbed, and it was estimated that the water holding capacity of the soil was doubled.

Get acquainted first hand with this farm-saver. Caterpillar builds the tractor and equipment, job matched for land reclamation and improvement. Talk with your Caterpillar Dealer, and plan a Better Land Use Day with him.

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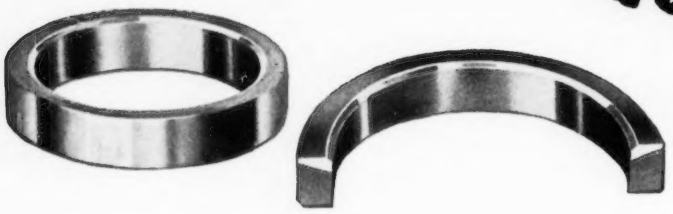

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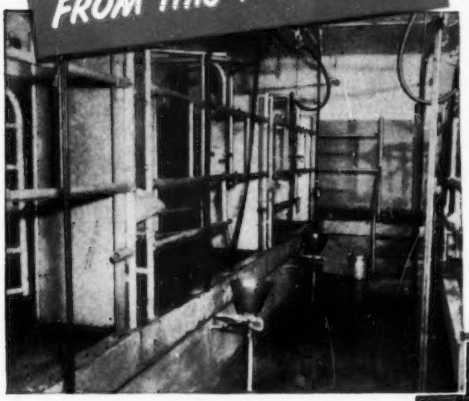
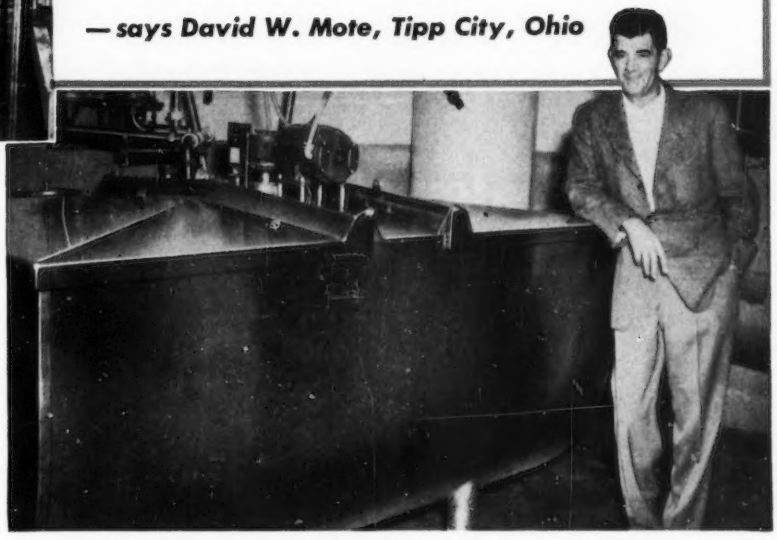


SIX-PLACE ELEVATED MILKING PARLOR where a single operator handles the job of milking Mr. Mote's herd of 90 Holsteins.

"Stainless Steel bulk equipment helps us handle a ton of milk a day untouched by hands and unexposed to air"

— says David W. Mote, Tipp City, Ohio



MR. MOTE and his 400-gallon Stainless Steel cooling and holding tank. Above the tank are Stainless piping and filters which halt the flow of milk when there is any interruption at the milker.

A group of milk producers in Ohio's Miami Valley has joined the growing list of dairymen who are saving labor and producing better quality milk through use of Stainless Steel bulk handling equipment, including milk line milkers and bulk cooling and holding tanks.

David W. Mote of Tipp City pioneered in the installation of bulk handling equipment in this area. At present, morning and evening milking of his herd of 90 Holsteins is producing a ton of milk a day.

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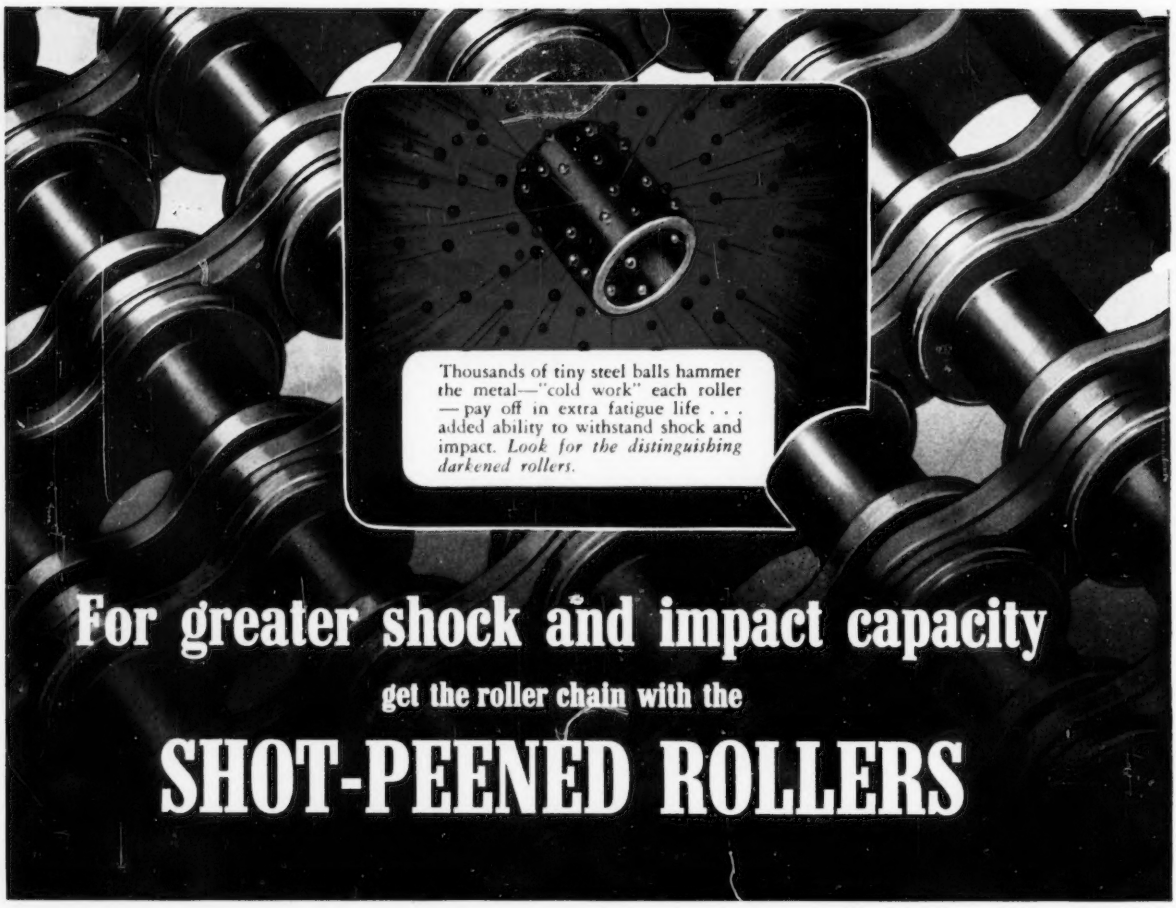
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EDITORIAL

Engineers Available

ONE unfortunate result of the current shortage of engineers is that some employers appear to have given up trying to find the men they need. That is a mistake. Good engineers are not as easy to hire as they once were but there are always some at the point of changing employment.

Well-qualified, highly-employable engineers often change employers several times during their careers, for reasons which cast no reflection on their professional ability or desirability as employees. Some seek varied experience as a means to continuing professional development. Some outgrow opportunities with their current employers. Employment policies of some employers encourage their engineers to offer themselves to the highest bidders on the professional slave markets. Some are forced to move by family health or other personal considerations. A few become victims of circumstances beyond their control. Choice of an employment and employer which may seem like a good idea at the time doesn't always work out. Professional employment is still far from an exact science. Continuing shifts of engineers for a variety of good and sufficient reasons represent opportunities for alert employers.

And notwithstanding competitive bidding for the services of new engineering graduates, some good prospects for graduate training are open to conviction as to the wisdom of accepting assistantships, fellowships or scholarships at present financial sacrifices, in the interest of their professional development.

The idea of having to compete for the services of engineers may still be new and slightly repugnant to some employers, including some engineers who are employers of other engineers. The condition exists. It seems due to become chronic. It may not prove fatal. The way to make the best of it is to keep opportunities open for engineers to develop and perform useful professional work to the limit of their individual capacities.

Sales Engineering

SALES engineers have sometimes been looked down upon over long and would-be aristocratic noses, as more than slightly sub-professional.

It is true that some engineered products can be and are sold with the pitchman's approach and reliance on one-shot sales to a continuing supply of new customers.

It does not follow that many sales engineers operate in this manner, or that it is the most satisfactory method of selling for the salesman, the producer, or the customer.

Our interpretation of what we have seen of this world leads us to believe that engineering can be most useful by application to a wide range of human activities with little restriction as to method of operation, so long as the boundaries of professional ethics are not overstepped.

One of those highly useful and effective methods is sales engineering. It can have the dignity of scientific truth, economic productivity, social justice, and artistic achievement. It can command the respect of the economic realist and the moral idealist. It can help support and give human significance to the work of the scientific theorist and the engineering purist.

The special merit of sales engineering is in study of the customer's problems in the light of thorough knowledge of the seller's product, and the experience of others in using the product. More often than is commonly realized the sales engineer will sell less than the purchaser thinks he wants to buy, or will kill entirely a sale not justified by the economic or engineering situation. Whatever his tangible product, what he really sells is customer satisfaction, good will, and reorder business. His work must be a continual denial of the old axiom that a bird in the hand is worth two in the bush.

Cynics may grudgingly credit the sales engineer's motives and methods as enlightened selfishness. Truly they are. A more liberal appraisal will also recognize him as a leader in expanding the frontiers of sound, progressive, productive business ethics.

The extent to which individuals sales engineers fall short of this ideal is probably no greater than the gap between ideals and actual practise in other forms of endeavor, the older learned professions not excepted.

Increasing complexity of engineered products and their applications is increasing the importance of the function of using special knowledge to guide the purchase and realization of optimum value from those products. That function has been and may continue to be well and favorably known as sales engineering. Don't sell sales engineering short as to technical merit, professional ethics or business leadership.

Borrowing for Profit

FARMERS are reacting to current uncertainties with a high degree of financial conservatism, according to a report from Iowa State College.

Results of a survey of farmers in southern Iowa indicate that they are generally disinterested in prospective profits to be realized by borrowing additional non-real estate funds. The survey showed that only 31.5 per cent of these farmers would borrow such funds for a highly probable return of 10 per cent on the investment. Another 39.0 per cent of the farmers indicated that they would borrow for a prospective return of 25 per cent on the money. A further 10.5 per cent wanted a bait of 50 per cent prospective return, and 5.7 per cent put their price at 100 per cent expected profit. A considerable number, 13.3 per cent, would not trade their financial independence for any level of prospective return.

These may sound like silly answers to a silly question, but we doubt that they were so intended.

Farmers know from experience that many things can happen between investment and cashing-in time to reduce a calculated "highly probable return." They know that few lenders are ready to share the risk to their capital which is always associated with agricultural production, no matter how "highly probable" the calculated return.

Many of these farmers may already be operating at the scale they personally prefer, with or without borrowed funds. Some may have properly discounted the hypothetical "prospective return" by prospective losses in other phases of their present programs, which might result from changes in their equipment, or the undertaking of additional operations.

(Continued on page 54)

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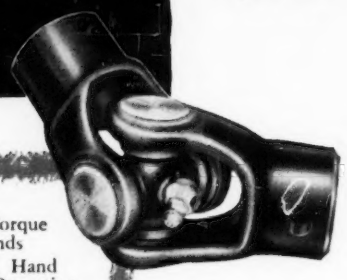

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N Series	Recommended Torque Rating, Inch Pounds	Balanced for
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5N	20,000	"
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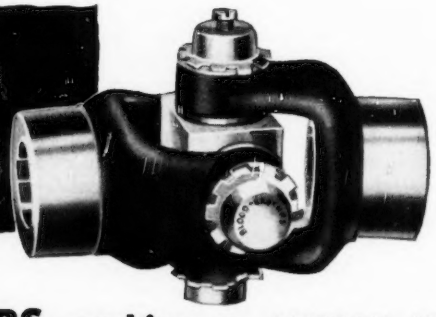

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AGRICULTURAL ENGINEERING

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Challenges Awaiting Agricultural Engineers in Farm Structures

By Deane G. Carter
FELLOW ASAE

FARM buildings are classed separately from other kinds and types of structures, mainly because they are connected with or attached to a farm, ranch, or plantation. Most farm building problems and their solutions are affected by this close relationship to farming. Separation into a non-industrial, non-urban classification has tended to minimize the importance of farm structures. Although the amount of improvement at any one time in any one community is quite small, the total value of farm buildings in the United States is about 20 billion dollars, and a billion dollars or more is spent each year for improvements.

The term "farm structures" indicates a farm location. But the diversity of structures needed for farming purposes and for meeting different situations calls for a wide variety of building types. Many kinds of livestock, different systems of farming, each change in locality, the variety of crops that are grown and processed, the construction materials found in a region, and the economic level of the farming unit all impose barriers to standardization and prevent the adoption of uniform plans and recommendations.

The term "farm food-production structures" would serve better to define the purpose of farm buildings. Then the problems of requirements and improvement would have more meaning to the public, for an adequate food supply is of concern to everyone. The buildings on farms are the factories from which a substantial part of the food supply comes. The quantity and quality of food in the future will depend in large measure on the kind of engineering that is applied to the betterment of farm buildings and on how well engineers interpret the factors of operation and management as they influence building planning.

Heavy penalties are being exacted from day to day and year to year for failure to recognize the high value of farm buildings as factors of production. Invariably the average quality of feed grains and cereals declines through the storage period from harvest time to marketing as a result of losses in quality that could be avoided by improved structures, equipment, and conditioning. The bulk of United States dairy products comes from the cooler regions where long winters impose a heavy duty on buildings and where advanced design must be applied to maintain the health of animals, promote efficiency in the use of labor, and safeguard the quality of milk.

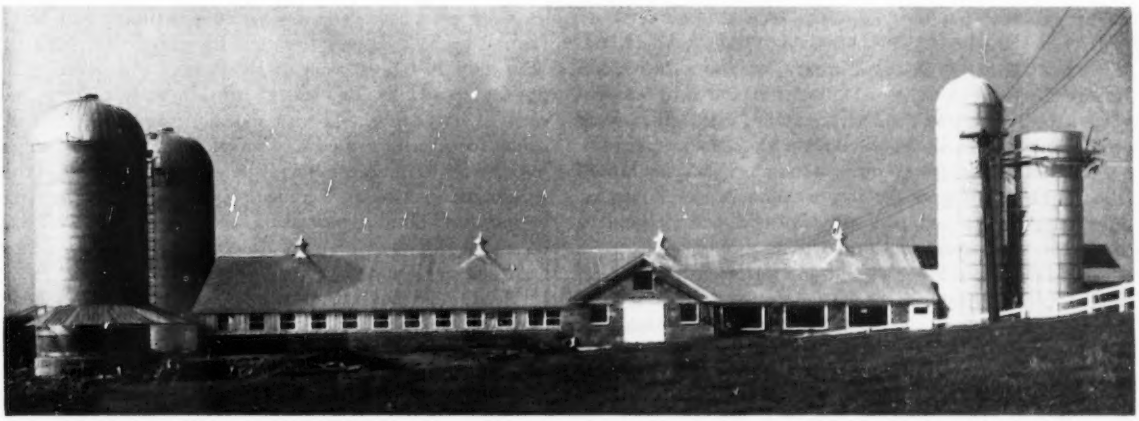
Labor is second only to feed costs in the production of livestock, poultry, eggs, and milk. Research has demonstrated that engineering of structures, methods, operations, and equipment can reduce labor, increase yields, and safeguard quality sufficiently to double the capacity of the farm worker.

Engineering is the primary influence, although not the only one, that will lead to the goal of efficient farm-production buildings. It is quite obvious that engineering must be applied to building designs that will withstand the destructive forces of wind, water, fire, insects, and decay; carry loads and pressures; resist wear; control heat, cold, moisture, and air movement, and utilize space, arrangement, and location effectively.

The engineer must invent and install equipment and devices to meet the needs of production, make the best use of materials and structural methods, obtain aesthetic and

An address before a special meeting of the American Society of Agricultural Engineers held in conjunction with the Centennial of Engineering Convocation at Chicago, Ill., September, 1952.

The author—DEANE G. CARTER—is professor of farm structures, University of Illinois.



A modern dairy barn with silos, hay storage, and milking parlor under construction on the farm of Edwin Adrienne near S. Deerfield, N. H.

functional values, and adapt buildings to many and varied situations. These are the expected services of the engineer. But more is required in order to meet the goals set for building improvment.

Engineering thought must be coordinated with the science of production and the principles and practices of operation and management. This implies a "science of farm structures" whereby the engineer is guided by new knowledge so that his designs may be adapted to the changing needs of agriculture and applied to the requirements of each situation.

The agricultural engineer is in the best position to contribute to the betterment of farm structures. Because of the position he holds in the organizations and institutions that serve agriculture, he has a primary responsibility for the application of engineering to the solution of farm-structures problems.

Agricultural engineers in the colleges of agriculture are responsible for teaching, research, and extension programs that are concerned with farm structures. Engineers in the U.S. Department of Agriculture are engaged in both independent and cooperative research and are associated with many public and private interests in an advisory capacity. Agricultural engineers or others who serve in comparable positions in industries, trade associations, and professional organizations directly influence the advancement of farm structures through planning, product design, promotion, consultation, sales, and services.

FARM STRUCTURES PRESENT DYNAMIC PROBLEMS

The engineer must recognize that the problems of farm structures are dynamic in character. The future is certain to bring changes that call for new solutions. Buildings that are adequate for one farm may not be suitable for another farm today, nor for the same farm in the future. A building designed for a profit-making enterprise might not do for a marginal or subsistence farm. Buildings must be designed for their special or specific use; adaptation to other purposes may be difficult, although adaptability is counted as a desirable feature.

The designer is faced with the three-fold problem of fitting old buildings to changing needs, of developing new buildings to meet current requirements, and of anticipating the demands that lie ahead. In dynamic terms, buildings should be defined according to their function — as laying houses, milking rooms, machinery storages, or crop-storage buildings — and not in static terms, such as machine sheds, corn cribs, hog houses, or barns. A building, when considered as an inert structure, can serve only as a shelter or a storage space, whereas its real value is measured in terms of what it contributes to productive capacity through planned arrangement, control of environment, and facilities for storage conditioning, management, sanitation, and saving of labor. The building of the future cannot serve its purpose until it is wired, piped, equipped, finished, and mechanized to vitalize it for operation.

Buildings should be accepted only for what they can do, the profits they will make, or the values they will preserve — in the same way that acceptance is accorded to other facilities for production, such as fertilizer, seed stock, and machinery. It is unfortunate, from this point of view, that building improvements are classed as a part of farm real estate instead of as operating equipment.

The influence of change is slow to be reflected in building improvements on farms. And yet each change in agricultural production affects the design and use of farm buildings. The relative permanence of buildings with average ages varying from 25 to nearly 50 years is coupled with far-reaching changes that have been accelerated since World War II. Thus today's buildings may be outdated in the future in the same way that older buildings have become obsolete as a result of changes in recent years.

Striking examples of change include the shift from animal power to tractors; from small machines to four-row machines, forage choppers, crushers, balers, combines, cotton pickers, and shelled corn harvesters; from natural drying to artificial crop conditioning; from the farm-sized poultry flock to the large-scale laying unit and broiler plant; from the dairy stall barn to the mechanized milking room; from hand labor to electric power, and from general farming to business-managed enterprises.

MECHANIZATION CALLS FOR REDESIGN OF STRUCTURES

Mechanization of crop production has been accomplished largely in the years since 1932. The number of tractors has doubled in the past ten years. Electric service now reaches three-fourths of all farms, with nearly complete coverage in many states. Soil conservation districts cover the major production areas, with emphasis on rotations, forage, legumes, and high yields. The net result is increasing pressure for the improvement of the farmstead — both in and around buildings—in order that the farmer may utilize his time and other resources to better advantage.

These farming changes call for drastic measures for re-analysis, revaluation, and redesign of structures. Much of the improvement in farm buildings in the past has been in the nature of details, additions, attachments or new models of traditional structures. The greatest need is for a new attack for the purpose of creating entirely new building facilities.

For many years improvement of silos has consisted of finding a better wall treatment, adding a roof, putting in more reinforcement, or planning a simpler method of erection. Important as these may be for durability, appearance, economy, or safety, the real challenges are to find ways and means to prevent the usual 5 to 10 per cent spoilage, to perfect a self-feeding method, to devise a mechanism for removal of silage, and to find economical ways to store, preserve, and handle large amounts of grass silage.

Corn cribs have been redesigned structurally with better frames, anchors, braces, ties, and coverings. But little has been done to take account of the storage and conditioning problem posed by long-season hybrids, early picking, mechanical harvesting, and high moisture; or to meet the demand for handling the crop out of storage and getting it into the feedbox. A completely new approach is needed that will result in a nearly automatic system of elevating, conveying, conditioning, processing, and distributing. This may do away with the corn crib altogether and call for a new basic design for a mechanized structure.

Traditional housing of dairy stock in stall barns generates its own problems of sanitation, ventilation, high labor requirement, and inflexibility in operation. Such improvements as watering cups, barn cleaners, comfort stalls, mechanical ventilation, and the like are merely expedients provided to overcome the faults inherent in the old system.

By contrast, an objective, analytical, engineering approach to the problem would emphasize function — that is, shelter for the herd, mechanized feeding and manure handling, and milking and milk handling to maintain high quality in the product and effective use of labor and management.

At present the dairy housing problem is complicated by prejudice or bias, by overemphasis on minor advantages and disadvantages of one system or another, by pressures that stem from market demands and cost factors, and by the assumption that the "milking parlor" is on trial. The final solution must be a rational one — that is, it must provide the most effective system in terms of efficiency, quality, and profit. The milking parlor, elevated stall, pipeline milker, milkroom, and other features are simply the resources available for design and application.

Electricity, liquid and gaseous fuels, scientific controls for infection and disease, production science, and practical management are fully as significant in the solution of housing problems as the structural elements themselves. As progress is made, final decisions will be made on the basis of total value. Engineering approaches that have given us the tractor, combine, rubber-tired equipment, and soil conservation methods can also be utilized to produce a higher level of building improvements for the farmstead.

Changes in farm structures are not effected quickly. They come about by slow evolution and over a long period of time. Far-reaching changes cannot be made until the resources are available—electric service, for example—or until popular demand plus research findings justifies a new design, such as for crop conditioning (which was not a serious problem before the era of hybrid seed, combines, and corn pickers). The engineer's responsibility is to accept new resources and anticipate demands rather than to delay until other pressures compel him to act.

TWO OBSTACLES FOR THE FARM STRUCTURES DESIGNER

In the development of new methods, the designer is faced with two obstacles: the relative permanence of farm structures and the natural resistance to change. Farmers have no alternative except to use a building until it is dilapidated or unusable. Most farmsteads have evolved step by step over a period of 50, 75, or 100 years. Plantings, roadways, and building locations become fixed. It is necessary to extend improvement plans over a generation or longer. Improvements are deferred during depressions and made in prosperous times. Buildings erected in 1950 may still be in use in the year 2000. Ideas that have been discarded by specialists are still being used in new construction because of the lag in the adoption of new practices.

Resistance to change is encountered among manufacturers, distributors, and builders because of financial and business interests. The tendency among public services is to permit building plans and publications to continue in circulation long after they have become outdated.

Effective solutions to farm-building problems in the future depend upon the following:

1 Recognition of the significance of farm buildings in terms of the money invested and the annual cost and the essential contribution of the buildings to efficient production.

2 Teamwork among all agencies and interests with respect to research and education.

3 Development of more trained people to fulfill the need for specialized activities in both industry and public service.

4 Promotion of a broad research program to determine the bases for adequate design. Research is the key to authoritative advanced design and recommendation. It should be given high priority in future programs. In the immediate future, research should be centered on (a) structural improvements, (b) environment, (c) processing, (d) methods of operation, and (e) equipment.

Research cannot be limited to isolated experiments nor to small-scale surveys, plans, or investigations.

Cattle-feeding studies show that travel time for distributing a ton of feed might be reduced 40 times over by using the best combination of methods found in a particular community. Far more study is needed, however, to verify the economical, effective organization of a feeding enterprise so that the typical cattle feeder can apply the basic principles of labor efficiency.

Corn-drying research has proved that artificial drying can be highly profitable. Research still to be done covers a range from rate of drying under various conditions and effect of heating on milling qualities to design of drying structures that use fuel efficiently and reduce labor cost.

Energy determinations indicate that at least seven times the effort is required to climb a ladder as to walk on the level. This is a far more potent argument in favor of one-story over two-story barns than all other comparisons combined.

THE GOALS FOR FARM STRUCTURES

Soybean storage studies are reported in a 48-page bulletin containing basic data which, if utilized, might save millions of dollars lost each year and repay the expense of the research many times over. In order to establish these findings, it required 50 farm-type buildings, 85,000 bushels of soybeans, and the equivalent of at least 15 man-years of time.

Production and profit are the ultimate goals of research, planning, and progress in farm structures. Unless these objectives can be reached, there is little point to the details of structure, arrangement, materials, or equipment. The farmer is concerned with the total facility, structure, machine, or method that will contribute to his program. And profitable production is the obvious first goal. "Build the barn, and the barn will build the house" is a philosophy familiar to the older generation.

The engineer must recognize, however, that he cannot limit himself to the material aspects of farm improvements. He cannot ignore the pride of ownership a farmer takes in a building that has more than a bare utility function. He must respect the farmer's desire to leave a heritage to his children. A sense of practical economics leads the farmer to obtain a measure of security by investing his profits in the farm and farmstead where they are safe from economic setbacks.

It is not by chance that farmers are now spending more for the improvement of their dwellings than for all other farm structures combined. The new houses built on many farms since World War II may cause the passerby to wonder, "How can they pay for a house like that?" The answer is that it is already paid for. Certainly, then, the engineer's purely technical approach to farm structures must be modified to include an appreciation of the social and economic

values that apply.

The engineer who charts a new course must inevitably sight on a known point, fix his present position, and take a foresight on the line he seeks to establish. From the vantage point of the present, much progress can be observed in the settlement of our country; in the changes from pioneer buildings; in the successive eras of animal power, general farming, and mechanization; through the destructive periods of war, debt, and depression; and in the trends toward specialized types of farming.

The present appears to be a point of division between the old and the new. This is perhaps true at any time, but the fact is that revolutionary changes have come about within the present century. In agriculture the great advancements have been in mechanization, soil and water management, plant and animal breeding, nutrition, disease control, and the application of business methods to farming.

NEED FOR CONSERVATION OF HUMAN ENERGY

The greatest lag has been in the area of farm structures and housing where, for lack of intensive application of science and because of conditions beyond the control of the individual, the farmer's home and his barns and storehouses are far out of line with other advancements. Today, however, the engineer finds powerful motives in the need for the conservation of human energy and in the desire for security and satisfaction.

Vast resources are available as the basis for design: electrical and other forms of power, knowledge from scientific research, and machines and materials of the industrial age. With these the engineer has the resources to integrate structural design, plans, and equipment with the best in production science, farm operation and management, and economic thought.

In summary, the opportunities that await agricultural engineers in farm structures are far greater now than they have been at any time in the past. They may be pointed up more precisely by the comments that follow:

The 20-billion-dollar valuation of farm structures in the United States and the billion-dollar annual expense for maintenance, replacement, and improvement are sufficient to justify vastly more attention to engineering design, plan, materials, and structure; to the training of specialists, and to research and promotion.

The general public must be concerned because of the influence of production buildings on the quality and quantity of the nation's food supply. The farmer is affected directly by the manner in which his buildings influence his profits and his operating efficiency. Other engineering developments, such as mechanization, soil and water engineering, and rural electrification, have created a revolution in agriculture which has changed farming systems, plans of operation; utilization of labor, and building needs. These engineering advances, along with developments in seed stocks, animal breeding, disease control, soil productivity, nutrition, and management, tend to focus attention on the farm-operating headquarters, or the farmstead.

It appears inevitable, therefore, that the next great engineering development in agriculture will be centered on the farmstead. At first glance the problem seems to be the simple one of replacing dilapidated buildings, getting rid of large haylofts, doing away with horse stalls, enlarging machine-shed space, or building a new house. In reality, however, the problem is more fundamental. Greater productive capacity has resulted in fewer farmsteads as small farms are merged into larger units. High production on the land creates a demand for comparable efficiency in and around buildings so that the farmer can obtain a year-round balance in his farming program and labor load.

Except for those farms where the principal income is from the direct sale of grain, hay, cotton, fruit, or truck crops, the farmstead has become the primary center of farm work—where machinery is sheltered and serviced; crops are stored, protected, and processed; animals are raised, sheltered, and tended; products are safeguarded as to quality; and the farmer and his family have their dwelling place. More than one-half the labor load on these farms is at the farmstead. It is here that the scoop shovel, pitchfork, feed basket, wheelbarrow, and water bucket must be supplanted by motors and mechanisms.

The complexity of production, the buildings, machines, and methods, the urge for efficiency, and market demands all require that farming be more highly specialized. The family cow, the small poultry flock, the single litter of pigs, and the small diversified enterprises must give way in profitable agriculture to larger, mechanized, and specialized enterprises.

The very phases of progress we regard as desirable create new problems, such as crop processing, feed handling, and large-scale enterprises that demand the same kind of engineering in and around the building as has already been applied successfully in field-crop production.

With new resources of power, mechanisms, and materials, the engineer faces a challenging opportunity to apply his talents to utilize light, heat, refrigeration, materials, motors, and appliances in the redesign of the farm physical plant.

Nor can the aesthetic side be overlooked. The designer and the economist cannot ignore the satisfaction, security, and comfort that stand high in the list of requirements for farm improvement.

Obstacles beyond the control of individuals are often mistaken for resistance to change. But fixed farmsteads, economic conditions, or vested interests of one kind or another may account for slowness of change and outdated features in many farmsteads. These obstacles can be overcome only by teamwork, education, research, and engineering design and planning. It is in these areas that the engineer will find his opportunity for farm structures development in the coming decades.

Purpose

ALL measures of success are relative. Some achieve fame, others fortune, according to certain standards. But under the microscope of one's own peace of mind the measure of one's personal success is this: "What have I wrought in myself that will give satisfaction, will render service, and provide joy in living and in work?" That measure of success any man may attain, and without it no accomplishment is worth the having. . . .

It is my firm belief that every man achieves the central theme of his life. Settle on a purpose and drive to that goal, whatever it is. You will be happy if you can learn to be of service.—C. G. A. Rosen, in *Mechanical Engineering* for December, 1952.

Performance of a Corn Picker-Sheller

By D. E. Burrough and R. P. Harbage
ASSOCIATE MEMBERS ASAE

A RELATIVELY new machinery development in the mechanization of corn harvesting is the picker-sheller. It has displayed definite labor-saving possibilities and has aroused considerable interest among machinery-minded corn growers. However, very little information is available concerning the performance characteristics of this machine. In order to evaluate some of these factors, tests were conducted during the 1950 and 1951 harvesting seasons.

The objectives of these tests were (*a*) to evaluate the effect of harvesting date on the efficiency of the picker-sheller and (*b*) to determine the crop characteristics which had a major effect on the operation of the sheller unit.

The machine used in these tests was a two-row picker-sheller. It is basically a two-row picking unit with the husking bed replaced by a cylinder sheller. The tractor used provided adequate power to operate the picker-sheller at 2.5 mph under the conditions of the test.

The performance tests were conducted in drilled hybrid corn. The crop condition was determined by counting the number of ears on down, leaning and standing stalks, and loose on the ground. Samples were taken during each test run to determine yield, picker losses, and sheller losses. The moisture content of the cob and of the kernels was also recorded for each test. The test data was corrected for moisture content to obtain yield and loss values in terms of No. 3 corn (17.5 per cent moisture).

The 1950 tests were made between November 6 and November 10 in a field of Indiana 813 hybrid. Thirty-four per cent of the ears were on leaning and lodged stalks and 24 per cent were on down stalks. Under these adverse conditions the picker losses averaged 7.58 bu per acre while the sheller loss was 0.90 bu per acre. The total yield (net yield plus losses) was 66.6 bu per acre with a kernel moisture content of 24.9 per cent. The losses (in per cent of total yield) were distributed as follows: loose ears on ground, 2.6 per cent; shelled at snapping rolls, 2.6 per cent; ears lost during picking, 8.9 per cent; sheller loss, 1.5 per cent.

An attempt was made to obtain test runs in a field of Indiana 680 hybrid corn on October 12, 1951. The kernel moisture content was 34.5 per cent. The performance of the sheller under these conditions was so poor that satisfactory tests could not be made. The sheller clogged when it was set to do a reasonably good job of shelling. When it was adjusted to permit uninterrupted operation, it left an extremely large amount of unshelled kernels on the cob.

Tests made a week later indicated that the sheller was leaving from 5 to 10 per cent, or more, of the total yield on the cobs. The kernels had a moisture content of 29.6 per cent, while the moisture content of the cob was 56.5 per cent. It was noted that the cobs were very spongy and were broken up by the sheller into triangular sections approximately two to three inches in length with some of the kernels still attached. Migrospora cob rot was found to be prevalent in the field. This is not common in Indiana and is probably of minor importance under normal conditions. However, this condition lowered the efficiency of the picker-sheller considerably in the tests. When using the picker-sheller under these conditions, it will probably be necessary to delay the harvest until the cob has dried out considerably and the corn shells easier.

Due to the difficulty of shelling the corn where this disease was found, the tests were conducted in another field which was planted earlier and did not have this infestation. All data illustrated in the accompanying curves were obtained in this early-planted field of Indiana 680 hybrid corn during the 1951 harvesting season.

PICKER LOSSES

The variation in increment losses and total picking loss are shown for the complete test period in Fig. 1. Picking losses include all losses not attributable to the sheller. The total loss due to the picking operation remained almost constant from October 25 to approximately November 23. The percentage of ears lost by the picker increased while the shelled corn loss at the snapping rolls decreased. This combination of losses tended to give a constant total loss for the picker during this period.

In late October, 70 per cent of the ears were on standing stalks, 15 per cent were on leaning stalks, and the remaining 15 per cent were on down stalks. On December 7 only 62 per cent of the ears were on standing stalks, 11 per cent were on leaning stalks, 24 per cent were on down stalks, and 3 per cent were loose on the ground.

Although a storm during the week of November 5 did not appreciably affect the amount of loose ears on the ground and the number of down stalks, adverse weather conditions during the week of November 20 caused a marked increase in the amount of loose ears and the number of down stalks. These two conditions plus an increasing tendency for those ears still

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The authors — D. E. BURROUGH and R. P. HARBAGE — are, respectively, assistant professor of agricultural engineering, Purdue University, and stress analyst, New Holland Machine Division, The Sperry Corp., formerly instructor in agricultural engineering, Purdue University.

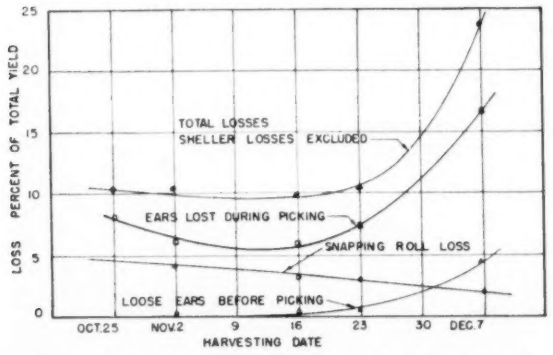

Fig. 1 Effect of harvesting date on losses in the picker method of harvesting corn

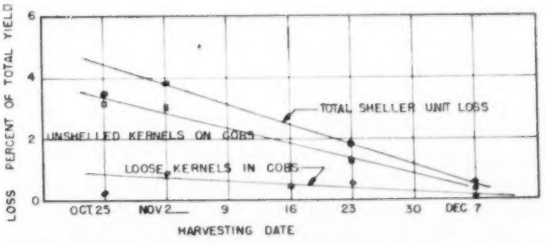

Fig. 2 Effect of harvesting date on the shelling unit losses in the picker sheller method of harvesting corn

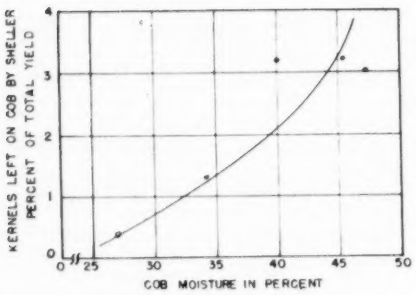

Fig. 3 Effect of cob moisture content on loss of unshelled kernels on cob by sheller unit

attached to the stalk to drop readily, contributed to the increase in picker losses.

SHELLER LOSSES

The sheller loss consisted of two components, kernels left on the cobs and loose kernels lost over the cleaning shoe. In both cases these losses appeared to decrease linearly with progressive picking date as illustrated in Fig. 2.

High kernel moisture content appeared to cause a build-up of shelled corn under the cleaning sieve to a point where all the shelled corn passed over the sieve without being separated from the cobs. To avoid this it was necessary to stop the forward progress of the machine and allow the separating unit to clear itself.

The greatest loss at the sheller occurred in unshelled corn remaining on the cob. As shown in Fig. 3, this loss decreased almost linearly with the decrease in moisture content of the cob. When the moisture content was high, considerable cob breakage was observed and the cob was too "spongy" for good shelling. These two characteristics appeared to be the major factors affecting the performance of the cylinder-type shelling unit used on the test machine.

HARVESTING DATE

A shift in the harvesting date from that recommended for the corn picker appears desirable when the picker-sheller is used. The performance curves for the two units when plotted against picking date, have opposing slopes. Therefore, the ideal harvesting date for the picker-sheller is not the same as that for the picker alone. The losses for each unit and their total in per cent of the total crop yield are shown in Fig. 4. The combination of the picking and shelling units in one machine has increased the loss during early harvest over that encountered with a picker alone. The use of the picker-sheller has, in effect, shortened the period of most efficient harvesting to about two weeks under the conditions encountered in this series of tests. The optimum time for the picker alone appeared to last over a four-week period under the same crop conditions. This raises the question as to whether this method has limited the amount of acreage that can be handled by this type of machine as compared with a standard two-row corn picker.

SHELLED CORN CONDITION

The effect of kernel moisture content on the percentage of mechanically damaged kernels was determined. At a kernel moisture content of 29.6 per cent about 14.5 per cent of the kernels by weight were damaged while at a 20 per cent moisture content only 4 per cent were damaged. This trend is illustrated in Fig. 5. The amount of foreign material found in the shelled corn was relatively constant at about 0.5 per cent by weight.

CAPACITY

The actual daily capacity of the picker-sheller was somewhat difficult to determine under the operating conditions found on the Purdue Electric Farm. The picker-sheller was

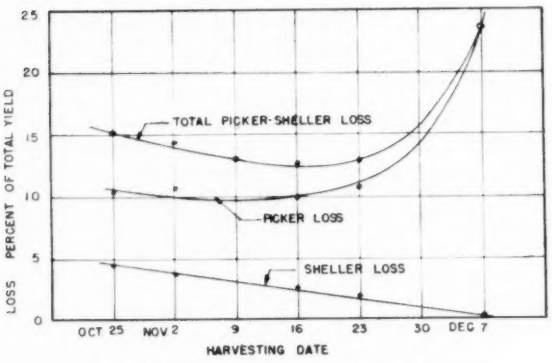

Fig. 4 Effect of harvesting date on picker-sheller losses

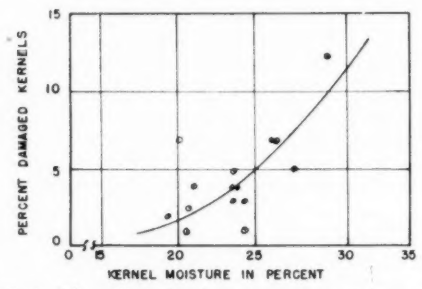

Fig. 5 Effect of kernel moisture content on percentage of kernels damaged by sheller

operated not more than four to six hours in any one day. With one man operating the picker-sheller and hauling the shelled corn to the drier, it was estimated that he could pick, haul, dry, and store about 600 bu of corn in an eight-hour day.

In 1950 the machine operated quite satisfactorily at ground speeds of 2.5 and 3.5 mph in corn having a total yield of about 66 bu per acre. The moisture content was about 24.5 per cent. In the 1951 season some difficulty was encountered in the operation of the picker-sheller at the higher ground speeds due to insufficient sheller capacity. The test area had an average total yield of over 77.5 bu per acre and the yield varied from 65 to 95 bu per acre on the 1/65-acre test plots. In the early season tests satisfactory shelling performance was difficult to attain at the lowest ground speed available, 2.5 mph. When the kernel moisture had dropped to about 20 per cent late in the season, the sheller handled the corn quite satisfactorily, at 3.5 mph, but this condition did not occur until about Dec. 1.

SUMMARY

1 The loss attributed to the shelling unit of the picker-sheller was only 1.5 per cent of the total yield during the 1950 harvesting season. In 1951 the efficiency was lower since the average shelling unit loss was about 3.2 per cent for the entire season and was considerably higher for early harvesting dates.

2 The sheller efficiency was affected adversely by high cob moisture content and by immature or diseased corn.

3 The percentage of kernels left on the cobs by the shelling unit was almost directly proportional to the moisture content of the cobs.

4 The most efficient harvesting period for the picker-sheller was shorter than for the picker alone. The sheller losses were high early in the harvesting season when the picker losses were low, and the picker losses were high when the sheller losses were low late in the harvesting season.

5 The percentage of kernels damaged by the shelling unit was almost directly proportional to the moisture content of the kernel.

Problems of Raindrop Impact Erosion

By Paul C. Ekern

THE velocity of falling rain (20 mph) exceeds by 10 and perhaps by 100 times the velocity of shallow surface runoff (0.2 to 2 mph). A runoff volume of 10 per cent of the total precipitation is frequently observed. The kinetic energy (proportional to volume times velocity square) for falling rain ranges from 1000 to 100,000 times the work capacity of shallow sheets of runoff water. The disposition of that tremendous quantity of kinetic energy expended by falling rain demands an explanation.

KINETIC ENERGY OF NATURAL RAINFALL

Drop Size. Best (2)* presented a comprehensive survey of the range of drop size found in rain. The frequency curve for drop size was skewed toward the large diameters with a maximum diameter of 7.2 mm. A value D_{50} was derived such that 50 per cent of the water in the air was comprised of drops with diameters smaller than D_{50}:

$$D_{50}=0.69^{1/n}\,A\,I^{P}$$

where I=precipitation intensity in inches per hour; A, n, p=constants with empirical values when D_{50} is in centimeters:

Source	n	A	p
Ynyslas	2.49	1.18	0.203
Shoeburyness	2.29	1.56	0.209
Lenard	2.59	1.42	0.272
Laws and Parsons	2.29	1.25	0.199
Canada	1.85	1.00	0.240
East Hill	1.99	1.38	0.269
mean	2.25	1.30	0.232

The median diameter (D_{50}) approximates a function of (intensity$^{0.232}$) and calculated after the relation would range:

Precipitation intensity, iph	Median diameter, mm	Intensity, iph	Diameter, mm
0.1	1.47	5.0	3.62
0.5	2.12	6.0	3.80
1.0	2.50	7.0	3.92
2.0	2.92	8.0	4.07
3.0	3.22	9.0	4.15
4.0	3.47	10.0	4.25

Blanchard (5) from laboratory study of drop stability found that all drops larger than 5.4 mm were broken apart when supported in turbulent air flow. When the air flow was smooth, only drops smaller than 7.7 mm were stable for any length of time. The maximum drop created by collision in these studies also agreed with the maximum diameter of about 7.3 mm found in natural rain.

Drop Velocity. Gunn and Kinzer (14) reported that drops smaller than 0.08 mm in diameter obeyed Stokes' law for their fall velocity. Deformation of larger drops decreased their terminal velocities. Spilhaus (17) developed an expression relating the terminal velocity of larger drops to the square root of the diameter which had reasonable agreement with experimental data for drops up to 4 mm in diameter. Gunn (14) found the following values for drops within the range of natural rain:

Equivalent spherical diameter, mm	Drop mass, micrograms	Drop terminal velocity, cm per sec
0.1	0.524	27
0.5	65.5	206
1.0	524	403
2.0	4190	649
3.0	14140	806
4.0	33500	883
5.0	65500	909
5.8	102200	917

HEIGHT OF FALL TO REACH TERMINAL VELOCITY

Laws (16) found the height of fall necessary to reach terminal velocity was of the order of 60 ft. Larger drops actually overran their terminal velocity at intermediate heights of fall. He tabled the following fall needed to reach 95 per cent of the terminal velocity of the drops:

Drop diameter, mm	Fall height, m	Terminal velocity (Gunn) cm per sec	mph
1	2.2	403	9.0
2	5.0	649	14.5
3	7.2	806	18.0
4	7.8	883	19.8
5	7.6	909	20.3
6	7.2	918	20.6

Drop Shape. When Blanchard (5) introduced large drops into a vertical stream of air, he found the drops oscillated in shape. Smaller drops oscillated from prolate to oblate spheroids in the vertical plane. Drops from 4 to 9 mm in diameter had only slight change in the vertical axis, but had their major oscillation in the horizontal plane. He presented the following horizontal dimensions for water drops suspended in an air jet:

Equivalent spherical diameter, mm	Minor axis, mm	Major axis, mm	Period of oscillation
5.0	5.00	5.75	44 per sec
5.5	5.60	6.50	
6.0	6.10	7.40	
6.5	6.65	8.30	16 per sec
7.0	7.20	9.50	
7.5	7.70	10.60	
8.0	8.30	12.00	
8.5	8.90	13.60	
9.0	9.45	16.20	7 per sec

Drops smaller than 1 mm in diameter remain essentially spherical as they fall. Spilhaus (17) calculated the theoretical flattening of drops at their terminal velocities as follows:

Equivalent spherical diameter, mm	Ratio of axes, vertical to horizontal	Ratio of cross section, sphere to flattened
2.74	0.9	0.93
4.50	0.8	0.86
6.52	0.7	0.79
9.0	0.6	0.74

For the impact character of natural rain, the effect of drops up to 7 mm in diameter, falling through distances up to 60 ft, to reach their terminal velocity and shape must be used in simulated precipitation intensity of the order of 3 to 6 iph.

DESIGN OF SHOWER HEADS FOR SIMULATED PRECIPITATION

Control of Intensity. Slowing the flow of water to make application of the order of 3 to 6 iph can be accomplished by several means. The design of nozzles to produce fine sprays is amply recorded (6). The primary objects are to slow the rate of application and insure even distribution.

This paper was presented at the winter meeting of the American Society of Agricultural Engineers at Chicago, Ill., December, 1951, as a contribution of the Soil and Water Division.

The author—PAUL C. EKERN—is instructor in soils and meteorology, department of soils, University of Wisconsin.

*Numbers in parentheses refer to the appended references.

Ellison (12) suggested the use of small holes to slow water flow. Ekern (10) used hypodermic needles for the same purpose. In each case the intensity was controlled by the head at which the water was supplied to the orifice.

Control of Drop Size. Water drops of known, easily reproducible size can be most readily formed as pendant drops from tips of fixed diameter. Edgerton et al (8) presented a review of work on surface tension and pendant drop formation. Detailed photographic analyses showed the formation of increasing numbers of secondary droplets with all delivery tips larger than 5 mm in diameter. The major secondary droplet averaged about 3 per cent of the volume of the primary drop. The maximum drop which could be formed was 7.2 mm in diameter from a delivery tube 20 mm in diameter. Ellison (12) devised an inexpensive method of drop formation using strips of yarns suspended from a gauze sheet to distribute the flow of water and force it to fall as drops. Drop size was controlled by the cross section of the yarn.

Control of Drop Pattern. The simulated precipitation intensity can also be altered by changing the concentration of drops per unit area, as well as by the rate of formation. Ellison (12) employed a concentration of one drop per 4 sq in. Ekern (10) used a pattern of one drop per square inch. No study has been made of the effect of variation of drop pattern on soil losses.

Drops given heights of fall necessary to approach their terminal velocities were deflected enough in falling to form a random pattern at the soil surface. With lesser heights of fall and large drops, the fall path is so straight that the soil target must be rotated, or the shower head oscillated to achieve a random pattern of impact on the soil surface. A small electric fan will move the yarn strips to make an even distribution of drops at the target when this type head is used.

Control of Drop Velocity. Drop velocity can be altered by changing the height of fall. The extreme heights necessary for the drops to approximate their terminal velocities makes the problem a tedious one. Further difficulty is encountered within shafts, for the entrainment of air by the drops creates a downdraft, even where the area initially is devoid of air circulation.

Control of Drop Shape. Pendant drops develop a definite period of oscillation which may be used to calculate the heights of fall which will insure that the drops have entered the same phase of oscillation at the moment of impact.

DESIGN OF SOIL TARGET

One method of measurement of impact loss has been to determine the decrease in weight of a small round target exposed to the simulated precipitation (13). To minimize the effect of the soil, a sieved separate of medium sand was employed. Bisal (3) reported that the removal of material from the container gradually slowed the rate of loss, but that a false bottom which allowed the soil level to be kept constant, made the rate of loss independent of time for medium sand.

Ellison (11) gained qualitative measure by collecting the most concentrated part of the splash patterns from larger targets by small splash boards placed normal to the slope of the soil surface. The material splashed onto the vertical board was collected and mechanical analysis allowed qualitative interpretation. However, conclusions from these experiments must be carefully drawn, for each increase in erosive force also increased the area from which material was gathered by the splash boards.

Ekern (10) used a small target of standard soil separates. In order to get reproducible results, it was necessary to use a ¼-in moat about the target to delineate a minimum distance of transport. The material splashed from the small target was collected on the inner surface of a cylinder of pipe which encircled the target. Dividers on the inner surface of the pipe coincided with the central cross-slope contour of the target and allowed the separation of the splashed material into down and upslope fractions.

Since the effects of drop impact are confined to a very shallow layer at the immediate surface, a soil layer of an inch or so in depth may be spread over an arbitrary base of porous sand.

Variation of slope can be easily accomplished by supporting the target on selected templates.

RESULTS

Successive variation was made of each factor that might influence the amount of soil loss from drop impact (9).

Total Volume Effect. When only the total volume of water was altered, the soil loss was directly proportional to the amount of water used. This fact precluded tedious duplication of precipitation intensity by allowing calculation to a basic reference intensity.

Area Effect. When the height of fall of a drop was used to increase the velocity of the drop, a net increase in soil loss was recorded, but superimposed on the curve was a series of regular rises and falls in the amount of transport from the target. Photographs showed that the points of minimum and maximum transport corresponded respectively with maximum and minimum horizontal cross section of the drop at the moment of impact. The small decreases of impact transport were found to be inversely proportional to the horizontal area of the drop.

Velocity Effect. When points were chosen so that the drop was in the same phase of oscillation (the horizontal area constant) or when the horizontal area was calculated constant, the amount of sand transported from the target was directly proportional to the square of the velocity of the drop.

Effect of Individual Drop Mass. The effect of drop mass alone was not directly evaluated. However, a calculated evaluation of the role of the individual drop mass can be made. The same mass of water was applied as drops of several sizes falling through 40 ft to approach their terminal velocities. By calculation, the velocity square and the inverse area of the drops can be evaluated. The total energy supplied by the same mass of water was a function of the square of the velocity. The total soil area to which that energy was supplied was a function of the number of drops, and the cross sectional area of each drop. The number of drops was found by dividing the total mass of water by the mass of the individual drop. The total area was $f\ (a/M)$, where a = individual drop area at moment of impact and M = individual drop mass. The energy per unit area supplied by drops (total energy ÷ total area) = $f(V^2M/a)$. The amount of transport by the same mass of water applied as small and large drops with varying velocities should be a direct function of the factor $f(V^2M/a)$.

When a plot was made of the data from large drops at less than their terminal velocities and from smaller drops

approaching their terminal velocities, a straight line relation was found approximating the relation $G = -0.5 + 0.1V^2M/a$.

From this data it was inferred that the erosive force of small drops falling at their terminal velocities can be duplicated by large drops falling at lesser velocities. This was a most convenient relation, for large drops are more easily formed and the effect of most small drops can be obtained by fall heights of about 10 ft, rather than the unwieldy height of 60 ft needed for the small drops to reach terminal velocity. A certain minimum impact was necessary to initiate transport, which for fine sand approximated the impact of a 1-mm drop falling at terminal velocity.

With the soil factor remaining constant, the erosivity from drop impact was found to be:

$$\text{Erosivity} = F\ \frac{(\text{intensity} \times \text{time} \times \text{drop mass} \times \text{drop velocity}^2)}{\text{drop cross section at impact}}$$

EFFECT OF SOIL FACTORS

Texture. Fine sand allowed optimum transport by drop impact. Larger separates underwent less movement because of the weight of the individual particles. Finer separates allowed the formation of a surface seal and the accumulation of water films on the soil surface to decrease the amount of soil loss. The following relation was found:

Separate size	Diameter limits, mm	Relative amount of transport (5-min interval)
Coarse sand	0.84-0.59	30.0 per cent
Medium sand	0.42-0.25	77.2 per cent
Fine sand	0.25-0.175	100.0 per cent
Very fine sand	0.10-0.05	61.0 per cent
Silt	0.05-0.002	21.0 per cent

Aggregates. Bay (1) in work at LaCrosse on the preparation of seedbeds showed a marked influence of clod size on both amount and time rate of removal of soil subjected to drop impact.

Ellison (13) found that 5.1-mm drops falling 18 fps moved some soil fragments through a distance of 5 ft, while 2-mm fragments were moved 16 in and 4-mm fragments as much as 8 in.

Slope. The distribution of the splashed material was found to depend directly on the slope. Ekern (9) determined the following relation:

$$\text{Per cent downslope movement} = 50 + \text{slope per cent}$$

$$\text{Net soil loss} = \text{downslope} - \text{upslope} = f(2 \times \text{slope})$$

Effect of Surface Films of Water. Current work by King (15) showed that even extremely thin films of water on the soil surface absorbed the drop impact and greatly reduced the amount of soil loss. A ½-in film of water offered complete protection to the structure of the soil.

Sealing. Ellison (13) reported work wherein the final infiltration capacity of bare soil under simulated precipitation was a function of the velocity of the impacting drops. Re-evaluating his data the infiltration rates after 1 hr were found approximately inversely proportional to the drop velocity squared. This was in agreement with work of Bisal (4) wherein soil was found to reach a minimum infiltration rate which required the application of a fixed quantity of impact energy.

Quantitative Evaluation of Results. A valid question concerning the effectiveness of impact erosion is how much material was moved. Calculation for the removal by the theoretical energy supplied in storms gave the following amounts of fine sand moved in 5 min:

Intensity, iph	Fine sand moved, tons per acre
0.1	0.05
0.5	0.52
1.0	1.33
2.0	3.32
4.0	8.00
6.0	13.35

Problem Areas to Be Considered. Laboratory investigation of drop impact must deal with the nature of the force of the impact, and also with the variable resistance of the soil to that force. The bulk of the work to date has dealt with the nature of the force. Every effort has been made to eliminate the soil as a variable. The impact of the drop directly onto the soil surface of fine-textured materials results in the formation of compaction planes known as surface sealing. Day and Holmgren (7) reported work on microscopic changes in soil structure under compaction from macroforces. A detailed study of the mechanics of the formation of the surface seal must be made. This compaction allows water films to accumulate on the soil surface, which greatly reduce the amount of impact movement of soil. However, the accumulation of water on the surface initiates runoff which brings new forces into play.

The falling drop adds tremendous vertical velocities to shallow sheet flow of water. Evaluation of the mechanics and the efficiency of this combined force of drop impact into shallow flows of water will bring to light the nature of the sheet erosion process. Extensive literature is available on the mechanics of stream flow. However, the combined flow and impact is understood only in part, while it accounts for 95 to 100 per cent of the sediment removed from individual farm fields.

The role of wind has not been evaluated, though it must greatly alter the velocity of the falling drops, and help determine the distribution of the splash.

SUMMARY

The nature of the erosive features of impacting force has been delineated as:

$$\text{Erosivity} = f(\text{precipitation intensity} \times \text{time} \times (\text{drop mass}/\text{drop cross-section}) \times \text{drop velocity}^2).$$

This force was shown effective in the movement of fine sand. Approximately 8 tons per acre of fine sand would be transported by the impact of drops from a rainfall of 4 iph continuing for a 5-min period.

This force was shown to distribute the material over distances up to 5 ft, with a preference for the downslope direction determined as

$$\text{Downslope per cent} = 50 + \text{slope per cent}$$

The role played by soil factors was pointed out as an area needing study, especially the factors attendant upon the formation of the soil seal at the surface.

The mechanics of drop impact when combined with shallow flow of water in the process defined as sheet erosion was another area which needs to be investigated so that agronomic practices may be designed to offset this most devastating erosional phenomenon.

REFERENCES

1 Bay, C. E.: Unpublished data. LaCrosse Experiment Station.

(Continued on page 28)

Design of Nailed Trussed Rafters

By Paul W. Stoneburner and E. George Stern
ASSOC. MEMBER ASAE

MORE than 100,000 housing units in the United States made use of split-ring connectored trussed rafters during the past six years. With the information available today on nailed trussed rafters, it can be expected that such trussed rafters will be employed for roof construction to an even greater extent because of their many inherent advantages.

On the basis of 44 tests on 26-ft-span trussed rafters, typical designs were developed for such roof structures, as shown in Figs. 1 and 2. In comparison with the split-ring connectored and bolted trussed rafters of standard designs, a considerable amount of lumber is saved if nailed or Burrlock-assembled trussed rafters are used. In comparison with nailed trussed rafters using plywood gusset plates and 176—8d nails in single shear, as recommended on the basis of three tests sponsored by the National Housing Agency in 1947, the new simplified design for nailed trussed rafters (1) does not require the use of plywood for gusset plates and (2) employs a considerably smaller number of nails in double shear. Thus, plywood does not have to be used, the time required for assembly is decreased, and the possibility of lumber splitting is reduced.

The comparative performance of representative nailed, Burrlock-assembled, bolted, and split-ring connectored trussed rafters is graphically presented in Fig. 3 as a combined function, that is, a ratio of the load-carrying capacity at allowable deflection and the deflection at design-load equivalent. Thus the greater the load-carrying capacity and the smaller the deflection, the better is the performance.

Bolted trussed rafters show the least satisfactory performance, although they require more lumber and cost more than any of the other assemblies. Connectored trussed rafters are next in the increasing-performance and decreasing-cost scales, followed in sequence by Burrlock and nailed assemblies. Thus, in general, the nailed trussed rafters give the most satisfactory performance despite the fact that the materials cost is less than for any of the other assemblies.

Trussed rafters assembled with Burrlock fasteners require a minimum of materials and are quite satisfactory structurally. However, joint assembly is difficult unless a

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The authors—PAUL W. STONEBURNER and E. GEORGE STERN—are, respectively, formerly assistant agricultural engineer, Virginia Agricultural Experiment Station, now with the Atlantic Aluminum Co., Waynesboro, Va., and research professor of wood construction, Virginia Engineering Experiment Station, Virginia Polytechnic Institute.

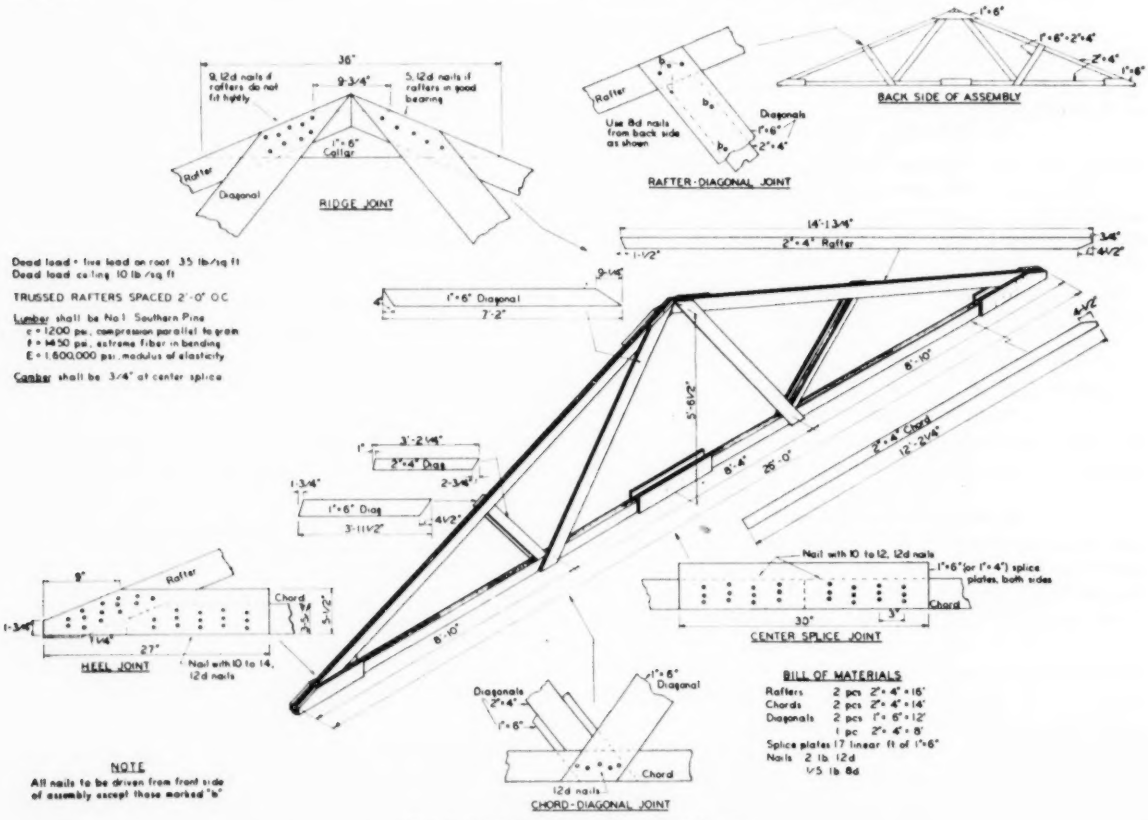

RIDGE JOINT
RAFTER-DIAGONAL JOINT
BACK SIDE OF ASSEMBLY
HEEL JOINT
CENTER SPLICE JOINT
CHORD-DIAGONAL JOINT
BILL OF MATERIALS
Rafters 2 pcs 2"×4"×18'
Chords 2 pcs 2"×4"×14'
Diagonals 2 pcs 1"×6"×12'
1 pc 2"×4"×8'
Splice plates 17 linear ft of 1"×6"
Nails 2 lb 12d
½ lb 8d
NOTE
All nails to be driven from front side of assembly except those marked "b"
Dead load = live load on roof 35 lb/sq ft
Dead load ceiling 10 lb/sq ft
TRUSSED RAFTERS SPACED 2'-0" OC
Lumber shall be No 1 Southern Pine
c = 1200 psi, compression parallel to grain
f = 1650 psi, extreme fiber in bending
E = 1,600,000 psi, modulus of elasticity
Camber shall be 3/4" at center splice

Fig. 1 Nailed trussed rafters of 26-ft span

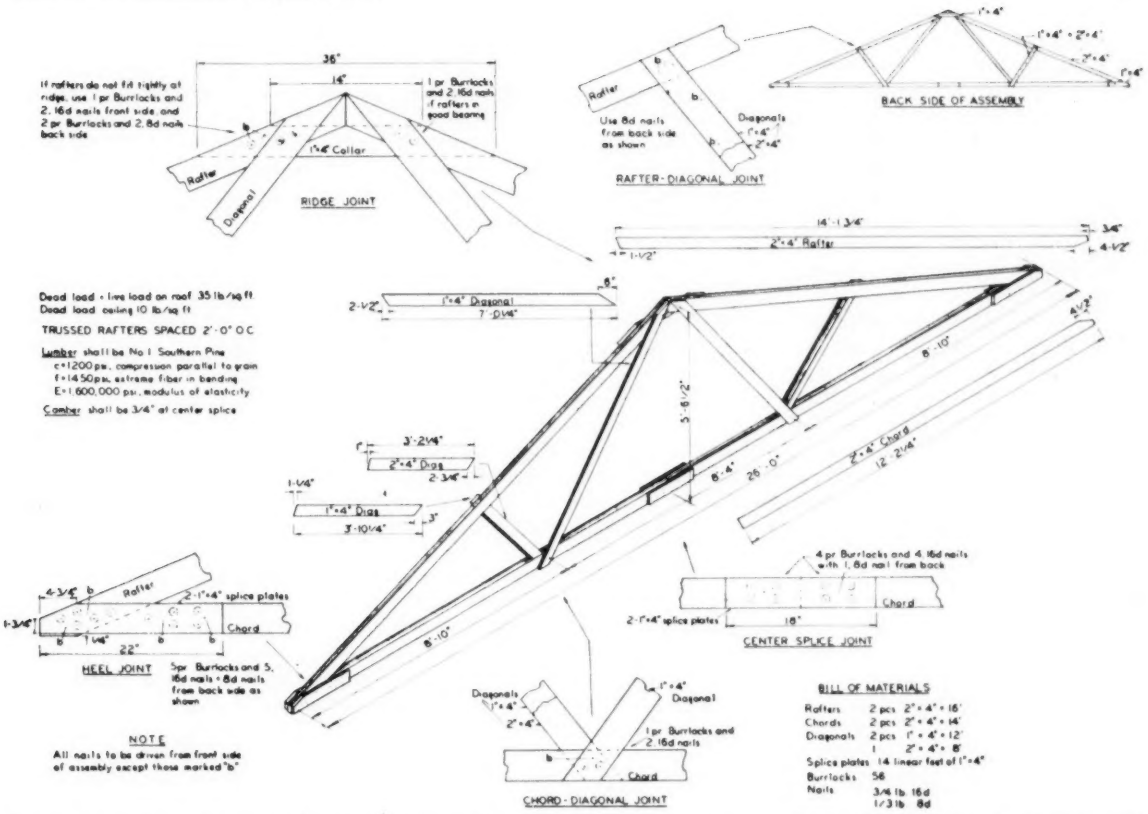
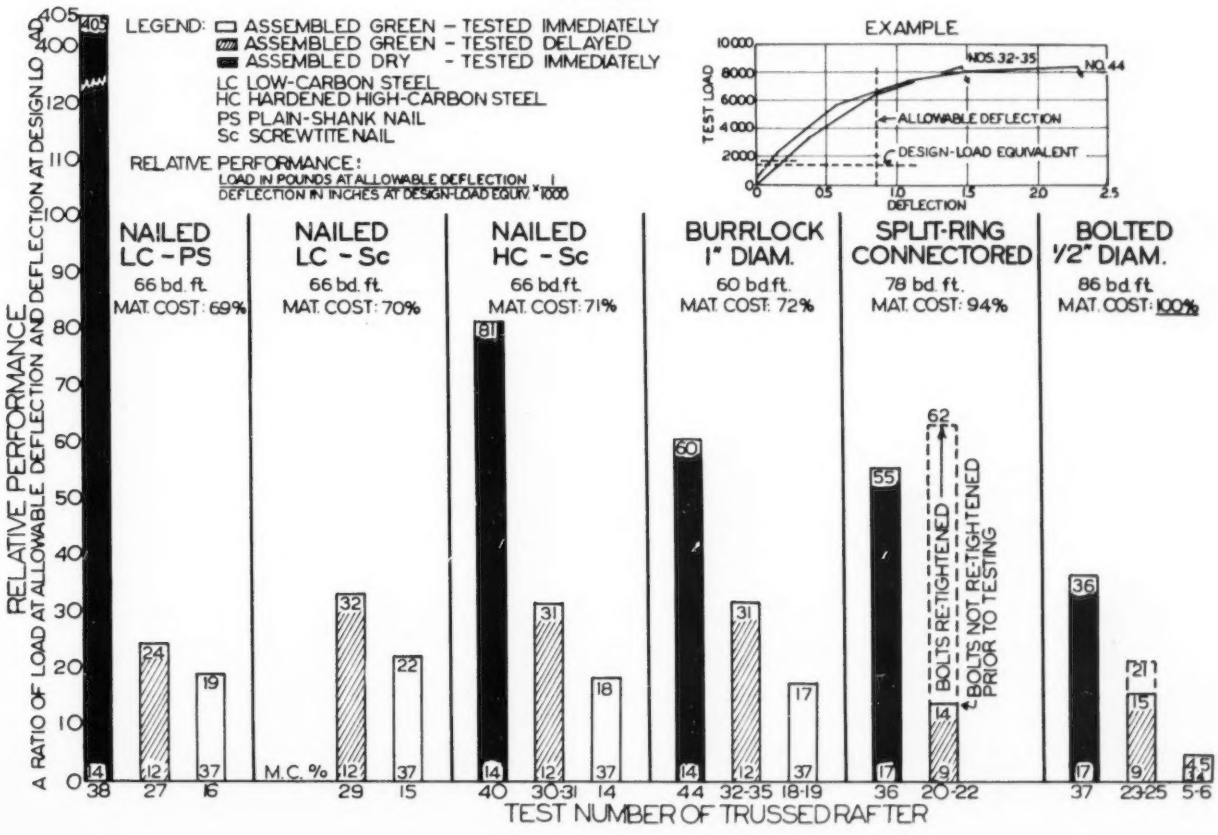

If rafters do not fit tightly at ridge, use 1 pr Burrlocks and 2, 16d nails front side, and 2 pr Burrlocks and 2, 8d nails back side
1"×4" Collar
Rafter
Diagonal
RIDGE JOINT
Use 8d nails from back side as shown
Diagonals 1"×4" 2"×4"
RAFTER-DIAGONAL JOINT
1"×4"
1"×4" + 2"×4"
BACK SIDE OF ASSEMBLY
Dead load + live load on roof 35 lb/sq ft
Dead load ceiling 10 lb/sq ft
TRUSSED RAFTERS SPACED 2'-0" O.C.
Lumber shall be No. 1 Southern Pine
c=1200 psi, compression parallel to grain
f=1450 psi, extreme fiber in bending
E=1,600,000 psi, modulus of elasticity
Camber shall be 3/4" at center splice
14'-1 3/4"
2"×4" Rafter
1"×4" Diagonal
2"×4" Chord
12'-2 1/4"
26'-0"
HEEL JOINT
2-1"×4" splice plates
Chord
Rafter
5pr Burrlocks and 5, 16d nails + 8d nails from back side as shown
4 pr Burrlocks and 4, 16d nails with 1, 8d nail from back
CENTER SPLICE JOINT
Diagonals
1"×4" Diagonal
1 pr Burrlocks and 2, 16d nails
CHORD-DIAGONAL JOINT
NOTE
All nails to be driven from front side of assembly except those marked "b"
BILL OF MATERIALS
Rafters 2 pcs 2"×4"×16'
Chords 2 pcs 2"×4"×14'
Diagonals 2 pcs 1"×4"×12'
1 2"×4"×8'
Splice plates 14 linear feet of 1"×4"
Burrlocks 56
Nails 3/4 lb. 16d
1/3 lb. 8d

Fig. 2 *(Above)* Burrlock trussed rafter of 26-ft span • Fig. 3 *(Below)* Relative performance of nailed, Burrlock, bolted, and connectored trussed rafters



satisfactory method is provided to apply easily the required pressure for complete assembly of the joints.

The effect of moisture content on the performance of the four types of trussed rafters is also demonstrated. Thus trussed rafters assembled with dry lumber and tested immediately carry greater loads at less deflection than those assembled with green lumber and tested either immediately or after lumber seasoning, with the exception of the ring-connectored trussed rafters assembled with green lumber, subsequently air-seasoned, and tested only after retightening of the bolts.

There are several factors of importance, as determined in the investigation, that need to be given consideration by the designers of nailed trussed rafters. Although enough nails can be placed even to overdesign the nailed joint, splitting of the lumber limits the number and shank-diameter of nails to be used in a given joint. The splitting tendency of lumber increases with decrease in moisture content and increases with decrease in lumber thickness. Splitting also increases as the distance between nails decreases, and as nails are aligned with the grain of the lumber. Also, the larger the diameter of the nail used, the greater is the splitting tendency. On the other hand, properly designed helically threaded nails that rotate as they are driven cause less splitting than equivalent-diameter plain-shank nails.

Hence, according to experience gained during this investigation, the following conclusions can be advanced with respect to nailing three-member southern pine joints:

1 Nominally one-in-thick splice plates present the greatest splitting hazard, especially if the bearing beneath the joint is not firm during nailing.

2 Nails should be used that have the required length, and yet the smallest diameter possible that will allow their driving without buckling. Thus the 12d 3¼ x 0.148 in low-carbon-steel plain-shank nails may be driven into dry (12 per cent moisture content) southern pine, however, only with some difficulty due to their limited buckling resistance, while the equivalent threaded-shank nails cannot be driven without buckling because of their larger driving resistance. On the other hand, the 3¼ x 0.135 in hardened high-carbon-steel threaded-shank nails can be driven easily without any danger of buckling and with the least wood splitting. Hence, the use of hardened high-carbon-steel nails is to be recommended whenever splitting might be a serious design limitation.

3 Spacings of 3 in (20 d) for nails in a row and ½ to ¾ in (3 to 5 d) between rows are satisfactory in southern pine.

4 Alternate nails in a row parallel with the grain should be offset about 2 d to avoid too much concentration in any grain line.

Although all nails in the assembly may be driven from one side, in the case of the use of plain-shank nails the tension members should be nailed from their side so that the tension members will not pull off the nails which would be the case under heavy load with nails driven exclusively from the opposite side. However, threaded-shank nails can be driven from either side of the assembly because of the increased holding power of the threaded portion of the shank.

Thus, non-hardened low-carbon-steel and, especially, hardened high-carbon-steel, helically threaded Screwtite nails offer numerous advantages and should be employed under any adverse conditions since their use eliminates many difficulties otherwise encountered in the design of nailed joints. This use of non-hardened and hardened helically threaded nails increases the materials cost per trussed rafter only 1 and 2 per cent, respectively; hence, should be economically feasible under any conditions.

It is helpful to have available either slightly more or longer pieces of lumber than required so that the carpenter has an opportunity to select the members or saw them in such a way as to avoid nailing into areas with splits or unsound knots.

An assembly jig is a necessity for speed and accuracy in assembling a number of trussed rafters, and a pattern for marking the locations of nails in each joint is helpful.

Although hammering will force the Burrlocks into the lumber, pressing is much more satisfactory. To facilitate the assembly of the Burrlock joint, the individual fasteners should be hammered to final depth into the thinnest member of the assembly. Then less splitting can be expected during driving of individual Burrlock fasteners and during subsequent nailing because splitting along the nail may be limited by the surrounding fastener to the area within the fastener. Thus to limit the extent of any possible splitting, all nails should be driven through the centers of the Burrlock fasteners.

Although the type and number of tests performed indicate their exploratory nature and limitations, the test results demonstrate the structural and economic advantages of nailed trussed rafters as compared to those assembled with other mechanical fasteners. Nailed assemblies are especially suited to field construction, and particularly to rural construction as only nails and a hammer are required for joint assembly, and the skill needed for satisfactory nailing can be quickly acquired by most workmen.

Problems of Raindrop Impact Erosion

(Continued from page 25)

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A Study of Soil-Water Movement by Electroosmosis

By Guy O. Woodward and W. McNab Miller
MEMBER ASAE MEMBER ASAE

THIS paper was prepared for purpose of assimilating the majority of published references dealing with the electrical treatment of soils. It is intended as general information for persons who may become associated with what appears to be a developing interest in the possibility of electrical drainage of agricultural lands.

The authors do not consider themselves authorities in the field. They have attempted rather to accumulate salient points from research papers on the topic.

There is no universal agreement on the basic processes, the exact results which may be forecast, nor on the economic feasibility for either large-scale drainage or soil-consolidation operations. Sufficiently definite results of a provocative nature have been found warranting consideration and investigation of the possibilities that drainage of agricultural soils have a heavy texture or adverse structure, making ordinary drainage methods impossible. Considerable irrigated acreage in the western United States falls into this category.

Electroosmosis may be defined as the movement of a liquid through a porous medium (soil) under influence of an electric field.

The principle of electroosmosis has been known and used for a number of years (6)*. Its main application has been in use of an electrochemical means of soil stabilization for foundations where wet, dispersed clay was to be used as a base on which heavy structures were to be built.

Casagrande explains the theory upon which such movement is predicated by stating that the quantity of liquid moved in a unit time under a potential difference can be derived from the modified Helmholtz equation for the flow through a single capillary. Casagrande further states (28) that, if applied to a bundle of capillaries of a cross-sectional area A, the corresponding flow, unlike the hydraulic flow, is independent of the individual pore sizes. The equation may be similar to Darcy's equation

$$Q = k_e i_e A$$

where Q = flow (cm^3 per sec)
k_e = coefficient of osmotic permeability (cm per sec per volt per cm)
i_e = electric gradient (volts per cm)
A = cross-sectional area of soil × per cent porosity (cm^2)

Geuze et al (15) working with development of osmotic pressure (free drainage was not permitted), developed a formula for the osmotic coefficient

$$k_e = hk/U$$

where k_e = coefficient osmotic permeability
h = maximum pressure in cm H_2O
k = hydraulic permeability
U = electrical tension in volts

Schaad states (20): "With regard to the physical research of electroosmosis the fact must be considered that the formulas deduced by Helmholtz neglect several remarkable influences. Electrical current does not only produce electroosmosis; parallel to it electrolysis takes place as a result of the galvanic current in the capillaries. It causes the decomposition of the liquid. Further, the conductivity of the soil particles is neglected. The former and later experiments of numerous physicists (*e.g.*, Quincke, Jllig, and Schonfeldt) on electroosmotic flow through capillaries and diaphragms show, that this flow decreases with increasing diameter of the capillaries or voids. The formulas of Helmholtz mentioned in L. Casagrande's report give the opposite effect. From a capillary of infinite diameter, an infinite electroosmotic discharge would result. This effect is contrary to every test result.

"The use of formulas for the determination of the relation between diameter of capillaries and transported charges also leads to results contradictory to experience. A more accurate consideration of the phenomena leads to a division of the electric current into three phases already mentioned by Smoluchowski. The current is composed by a galvanic phase of current transporting the ions in both directions (anodecathode, cathode-anode), a surface current transporting the charges of double layer, and a third phase flowing through the solid particles. Therefore, the form of velocity distribution in the capillary is not yet clear and will have to be found by physical research and reflexions.

"In laboratory tests the disturbance of electroosmotic effect by electrolytic decomposition of the liquid and electrodes is considerable. During the tests, polarization of the electrodes, increase or decrease of electrical resistance and exchange of ions between liquids and soil, and even inversion and oscillations of flow were observed. Acidity and basic concentration increase during long permeability tests (*e.g.*, electroosmotic rise tests) and change the electrokinetic potential of double layer and thereby the coefficient of electroosmotic permeability."

Despite the influence of the auxiliary effects of electroosmosis, Schaad states (20), "... these influences are less evident and less important in large-scale and field experiments than in laboratory tests. Experiences with filter wells showed that several days of flow of current did not change the electroosmotic discharge of the well point. For transmission of laboratory tests to field applications to calculations, we should therefore apply the values found in the beginning of the test, which is not yet influenced very much by accessory phenomena mentioned above."

To this effect Schaad developed the formula for height of rise of osmotic pressure

$$k_e = (Fd/OU)\tan\alpha_0$$

where k_e = coefficient osmotic permeability
F = cross section of piezometric tube
d = distance between electrodes
O = cross section of sample
U = electrical tension between electrodes
$\tan\alpha_0$ = initial slope of rate of pressure rise curve

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The authors—GUY O. WOODWARD and W. MCNAB MILLER—are, respectively, irrigation specialist, agricultural extension service, and assistant agricultural engineer, agricultural experiment station, University of Wyoming.

*Numbers in parentheses refer to the appended references.

He points out that this has the advantage of being independent of hydraulic permeability.

Work done by Barber (2) shows that the quantity of water transported, V, is proportional to the time, t, and the cross-sectional area, A; it is inversely proportional to the resistance to flow of water, K, and directly proportional to the force gradient which is the product of the charge, C, and the voltage gradient, E/L.

Thus, $V = tACE/KL$ is similar to the normal flow of water and the hydraulic gradient. Substituting the product of resistivity, R, and current, I, for AE/L gives $V = (t/K)CRI$. This indicates that the quantity of water, V, is proportional to the quantity of electricity tI. This agrees with work reported by Casagrande (6).

Fig. 1 shows the apparatus used by Casagrande in his work on electroosmosis. He used soil materials with hydraulic permeabilities ranging from 1×10^{-11} for sodium-bentonite (Wyoming) to 8.0×10^{-3} cm per sec for (horizontal) mica powder, including fine sand with a coefficient of 2.9×10^{-3}. It is interesting to note that the mica powder has a permeability about one billion times that for the bentonite. Despite these tremendous differences in hydraulic permeability, he reports: "The results obtained for the osmotic flow are very similar for most materials which were tested. From Fig. 5 (see accompanying Fig. 2) a magnitude of k_e of about 5×10^{-5} cm per sec per v per cm may be determined. The highly colloidal Wyoming bentonite shows greater deviation from this value for very small and very high water contents, reaching 12×10^{-5} cm per sec per v per cm with a water content of about 2000 per cent of dry weight."

Bernatzik (3), using quartz powder with a hydraulic permeability coefficient of 9.3×10^{-4} in an independent investigation, found a k_e of 6.8×10^{-5}. Geuze (15) and Schaad (20) found in their investigations that the osmotic permeability coefficient was not constant but decreased in the later stages of the experiments.

Three general stages of osmotic flow were observed in Casagrande's work. In the initial stage there was gradual adjustment of moisture distribution in the soil between the electrodes which became linearly distributed, decreasing from the anode to the cathode, the slope of this linear change being a function of the potential gradient, theoretically horizontal (same per cent at both electrodes) for an infinite potential gradient. Casagrande points out that the slope of this moisture gradient is the same for all soils with the same k_e. The second stage is that equilibrium period during which the outflow of the drainage water and the distribution of the moisture percentage throughout the soil remains constant. He does not report how long after initiation of the electromotive force the second stage occurs, nor what its duration is. The third stage begins on departure from the equilibrium conditions, with gradual accumulation of water behind the cathode steadily extending toward the anode, and at which time a laminated structure (as distinct from fissures) begins to develop in colloidal materials. During this period, drainage outflow and current flow decrease.

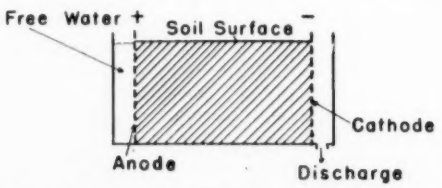

Fig. 1 Apparatus used by Casagrande (6) in his work on electroosmosis

Casagrande states, "The amount of current passing 1 cm² of soil depends largely on the grain size of the soil." (See Fig. 3.) He also investigated development of hydrostatic pressure at the cathode (in an apparatus for restricting drainage flow). Comparing the results against theoretical calculations based on the Helmholtz theory

$$P = 2ED/r^2$$

where P = hydrostatic pressure
E = potential difference
D = distance between electrodes
r = radii of capillary tubes

he found "the hydrostatic pressure with fine sand, sandy silt, and kaolin, derived from direct tests, show fairly good agreement with the theory. However, such agreement has not been found with soils containing a certain proportion of clay or colloidal particles, such as clayey silt, London clay, or bentonite. For these soils the pressure head developed at the cathode was found to be about 10^3 cm of water for a potential of 20 v.

"This water head corresponds to a flow in capillaries of a diameter of about 0.4, or, in other words, through a system of channels which are relatively coarse compared with the size of the particles. Together with the fact that clayey and colloidal soils develop a distinctly fissured structure under electroosmosis, and the observation that these fissures are filled with free water, *the water drainage from the cathode is transported through the soil in these fissures* (italics by the authors of this paper).

"In that case the formation of the fissures could be feasibly explained on the assumption that in clayey and colloidal soils the water does not flow according to Fig. 1 (refers to figure in original paper showing fixed and movable parts of double layer and free water away from particle wall), but rather prefers to open up cracks (fissures) to produce a freer passage." This may be intended to imply forcing open fissures by moving water. If so, Bernatzik disagrees. Based on laboratory comparison of hydraulic gradient versus flow velocity with and without an electric field, he concludes that pore-water streaming caused by electroosmotic action exerts no seepage pressure on the grains.

While not specifically suggested by Casagrande, who rather implies force opening of the fissures, it appears quite reasonable that these fissures are the direct result of shrinkage associated with decreasing water content of the colloidal material.

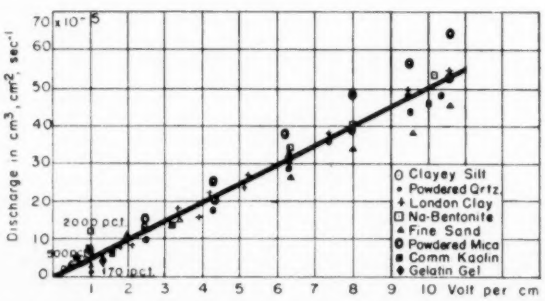

Fig. 2 Discharge of water by electroosmosis (after Casagrande)

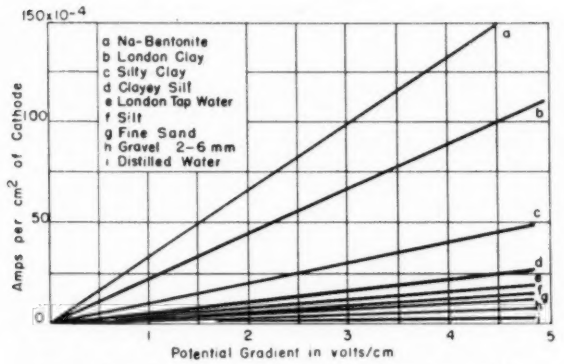

Fig. 3 Flow of current for various soils (after Casagrande)

Several investigators reported that the hydraulic permeability of a soil was lower after completion of electrical treatment than before. For example, Geuze (15) reports the hydraulic permeability for a peaty clay as 30×10^{-6} cm per sec before treatment, and 5×10^{-6} cm per sec after treatment. However, the apparatus used by all of these investigators consisted of a device for loading the soil column and maintaining a steady pressure to effect consolidation of the column, which would have tended to prevent formation of fissures discussed by Casagrande, and which he credits with transporting the majority of the drainage water in colloidal soils.

Casagrande (8) has summarized his findings in the following manner:

"1 The electroosmosis flow can be represented by an equation similar to Darcy's law, the coefficient of permeability being dependent mainly on the porosity and the Zeta potential.

"2 From the results of laboratory investigations it may be concluded that the quantity of flow does not vary considerably in view of the great differences in the soil materials tested and that for practical purposes in civil engineering it may be assumed to be of the magnitude of $k_e = 5 \times 10^{-5}$ cm per sec per volt per cm.

"3 The osmotic flow does not seem to take place through the individual pores of clay size or less, but through fissures which develop throughout the soil between the electrodes, even under a small potential gradient. This movement leads to the development of a hydraulic pressure which is the same for soils containing more than a certain proportion of colloidal particles.

"4 Though the osmotic permeability is very much higher than the hydraulic permeability for many soils, it is not sufficient to make the consolidation of soils within a brief period a commercial proposition. Nevertheless the fact that by these means it is possible to divert the flow of pore water away from unstable slopes and cuttings makes its use in this manner a valuable and highly economical method for earthworks and foundation engineering.

"5 Mention is made of the fact that the osmotic flow of water causes a laminated structure to develop in clayey soils and colloidal materials, apart from the random fissures. These laminations resemble strikingly some natural deposits of laminated clays."

Marwick and Dobson (17) made field trials, using well points as cathodes with anodes driven between the wells, and compared well yields with and without an electric potential.

TABLE 1. DRAINAGE WITH ELECTROOSMOSIS

	Depth, ft	WELLS Spacing in line, ft	WELLS Gravity alone, cu ft/day	WELLS Electroosmosis plus gravity, cu ft/day	Supply of electricity per well, volts	Supply of electricity per well, amps
Railroad cut	25	33	0.7 avg	105 avg	90	25
U-Boat Pen	66	33	0.8-34	7.7-320	40	20-30
TunnelApproach	40	33	Negligible	3.3 avg	30	15

*In double lines with anodes in parallel lines.

Success of this application has been rather limited to silty materials with size from 0.004 to 0.04 mm.

Schaad reports (20) "... with field experiments with filter wells that several days of flow of current did not change the electroosmotic discharge of the well point."

Some preliminary trials of the application of electroosmosis to agricultural drainage are reported to have been made by personnel of the U.S. Bureau of Reclamation on the Shoshone Project in northern Wyoming. No field data have been made available on this work.

Shrinkage phenomena associated with electrical treatment of soils has received considerable attention in relation to increased density and bearing strength of the resulting soil mass. This shrinkage is the well-known result of removal of non-free water from colloidal materials.

The literature does not too clearly differentiate between shrinkage and hardening. Hardening would appear to refer to an increase in bearing strength. Compaction of soil mass during shrinkage would certainly increase bearing strength and therefore hardening. However, an additional hardening may be caused by electrochemical reactions through ionic exchange. This exchange may restrict or prevent reversibility of the reaction under field conditions. The terms stabilization, consolidation, and settlement are frequently somewhat loosely used in referring to both hardening and shrinkage.

The first work of any significance was reported on this subject in 1936 (11). However, one article appeared in 1933 (25) using this principle. Two German workers (11) used metal electrodes in the soil at "appropriate spacings" using aluminum anodes and copper cathodes. "Appropriate voltage" of direct current was passed through until the clay hardened. These tests with a clay of 80 per cent water being treated "for some time" with 8-14 amp at 300-500 v caused the soil to become hard enough to withstand a 22-lb pressure on a 1 sq cm rod, and the rod could not penetrate the soil.

The sample did not disintegrate or swell on being immersed in water for several months. Their belief was that the charge gave rise to an exchange of the exchangeable cations, particularly sodium, it being exchanged for aluminum. The aluminum was said to have come from the aluminum anode, though they thought possibly the aluminum from the clay may have contributed to it.

Shrinkage of the clay from 30 to 40 per cent resulted, regardless of the water content, or even if a puddled condition existed before treatment.

Experiments with 14 v and currents less than 0.1 amp have raised the bearing capacity of the soil from 21 lb per sq in to 100 lb per sq in in 5 hr, to 206 lb per sq in in 20 hr, and to 242 lb per sq in soon after 20 hr.

A summary (21) of the work of two Russian scientists (19, 22) was made in 1947, although they themselves reported the work in Russia in 1941.

Densities and bearing strengths were increased by passage of an electric current through an otherwise undisturbed soil mass, 30 to 200 kw at 100 to 22 v direct current per meter at not over 20 amp per sq m. Copper cathodes and aluminum anodes were used, distances between the electrodes being from 0.5 to 1.0 m. There was no appreciable ground heating.

Besides the electroosmosis of water, substitution of aluminum for other replaceable bases and formation of aluminum

and iron gels are believed to be responsible for soil stabilization. Some of these stabilized clays have been immersed in water for 2½ years without visible signs of loosening. Stabilization has been accomplished in 5 to sometimes over 200 hr. Moisture was reduced from 50 to 20 per cent. 20 to 30 kw at 120 to 140 v direct current proved effective. A current of 2.3 ma per sq cm did not affect ground temperatures, but higher currents did.

Dawson and McDonald (10) examined the time rate of consolidation, using bronze electrodes on a loaded soil column. They observed a settlement of 0.04 in where a nonloaded sample was subjected to an electric current for 1 hr 30 min, allowed to stand with no current for 30 min, and then loaded. When the sample was given a pretreatment as above and the current maintained throughout the loading, the settlement was 0.032 in. When the current was applied at beginning of the loading period and continued throughout the test, the settlement was about 0.09 in, and where applied 30 min after settlement it was about 0.085 in. Where the sample received no treatment, the settlement was 0.065 in. It is to be noted that the electrical pretreatment appeared to harden the soil so that total consolidation was decreased. They report: "In addition to the effects of current discussed, there was a notable change wrought in the soil itself. Immediately adjacent to the positive electrode, the soil assumed a definite greenish tint, believed to be corrosion deposited from the copper in the bronze material of the upper porous plate. The negative electrode (bottom porous plate) was wet at end of the test, and the soil near this point seemed to bleach out to an almost pure white. The colors did not show up until the soil had been thoroughly dried out in an electric oven." Atterberg limits on these sections of the core after oven drying were:

	Original soil	Green layer	White layer
Liquid limit	43	40	38
Plasticity index	23	21	16
Shrinkage limit	12	14	19
Shrinkage ratio	1.81	1.82	1.68

Concentration of moisture at the cathode substantiates observations of Casagrande.

Barber reports that, if aluminum electrodes are placed in the soil and a direct current applied, the sodium cation migrates with the water toward the cathode and is replaced by an aluminum cation from the anode, which tends to bond the soil particles together, as a result in part of its high valence.

Casagrande (5) was granted a patent in 1937, on electrochemical hardening of soil. The patent simply refers to the theory as being not understood, but apparently relying on the exchange of sodium ions on the clay complex by aluminum ions to the effect that "the physical properties of the clay, after being treated according to the above description, are very much improved from the standpoint of the requirements of foundation engineering. The treated clay is much harder than the same clay of the same water content when not so treated, and it does not swell or slake when immersed in water."

His method consists of using an aluminum anode and a cathode consisting of some other metal. He explains that hardening may be accomplished by connecting the aluminum anode by a conductor to a metal which is less electropositive —possibly copper—and relying on galvanic current over a period of time to achieve hardening. He also claims use of an external source of direct current connected with electrodes to decrease the time required. In either case, multiple electrodes may be used in series. Further, he claims use of a solution of aluminum compounds (aluminum acetate and aluminum sulphate as examples) injected through or around the anode to increase the flow of current and to furnish an additional supply of aluminum ions to expedite the hardening process.

The idea of being able to drain heavy or dispersed soils electrically is intriguing, particularly if it offers a solution for seeped areas heretofore considered non-drainable. However, practical limitations must not be ignored in a first flush of enthusiasm. It may be well to generalize the main factors which will determine the practicability of large-scale field application of the process to agricultural drainage.

An immediate stumbling block may well be the relation of cost to monetary benefits derived. Casagrande states, "This work has not led the author to change his earlier opinion that the field of practical application of this method is likely to be limited on account of economic factors."

The power cost entailed in applying direct current to an adequate soil volume, and the labor and material (electrode deterioration, equipment outlay, etc.) costs will be considerable. However, to make cost estimates valid, many points must be clarified by information which is now, at best, uncertain.

It must be known whether it is necessary to place the entire soil volume to be drained under the electric field, or whether the field may be over a considerable smaller volume and by establishing osmotic pressure and hence a hydraulic gradient, force excess water outside the field in direction of least resistance (*i.e.*, to a drain), and induce upstream water to filter gradually into the volume of the electric field having lower moisture concentrations. This would affect not only the areal extent of the required electric field, but its vertical extent.

For valid evaluation, it must also be known whether or not an electric potential must always be used to move any water, or whether development of fissures and laminations — and possible electrochemical hardening to resist closure of the fissures by weight of the overburden — will be sufficient and durable enough so that sufficient permeability is developed that gravity drainage may thereafter become effective. Or will it not only be necessary to maintain an electric potential, but increasingly so due to gradual consolidation of the subsoil into a denser strata with a lower permeability than originally existed?

Would it be possible to achieve acceptable results, using only electrodes having an electropotential difference, connected by a conductor, relying on galvanic action to create the current and move the water as Casagrande used the process for soil hardening?

Should the process prove practical anywhere for agricultural drainage, it will of course necessitate much research — both field and laboratory — to determine optimum potential gradients, electrode composition, current and electrode consumption, duration of test, effect of placement on what might be called the "volume of influence," effect of soil type and composition of soil solution, and other questions which will develop in course of an investigation.

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Analysis of Border Irrigation

TO THE EDITOR:

IN THEIR article, entitled "Analysis of Border Irrigation," in AGRICULTURAL ENGINEERING for June, 1938 (vol. 19, pp. 267-272), M. R. Lewis and W. E. Milne, have contributed a valuable approach to the study of the hydraulics of surface methods of irrigation. However, attention is drawn to an error in their analysis. It is hoped that the explanation of this error and revision of some of their equations given here will add to the value of their work, and will help any irrigation engineer who may have found difficulty in fitting field observations to the form of their equation [9].

Lewis and Milne derive the final equation of their general analysis

$$cx = -\int_0^{t_x} y\,(t_x - t_s)\,x'\,(ts)\,dt_s + q^{t}{}^{x}/L \quad . \quad . \quad . \quad [2]^*$$

and obtain by differentiation with respect to t_x

$$ex' = -\int_0^{t_x} y'\,(t_x - t_s)\,x'\,(ts)\,dt_s + q/L \quad . \quad . \quad . \quad . \quad [3]$$

In their Example 1, they consider the form of the advance equation which corresponds to an absorption function of the type $y = b(1 - e^{-rt})$. The differential equation satisfied by y is

$$y' + ry = br \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad [7]$$

The use of this relation in equations [2] and [3] by Lewis and Milne is erroneous. In fact, multiplication of [2] by r, the addition of [3] and use of [7] gives

$$cx' + rcx = -\int_0^{t_x} brx'\,(t_s)\,dt_s + qrt/L + q/L$$

or $$cx' + r\,(b + c)\,x = qrt/L + q/L \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad [8a]$$

The particular solution of [8a], which vanishes when $t = 0$, is

$$x = \frac{\alpha}{k}t + \left(\frac{\beta}{k} - \frac{\alpha}{k^2}\right)(1 - e^{-kt}) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad [9a]$$

where $k = \dfrac{r(b+c)}{c}$, $\alpha = \dfrac{qr}{cL}$, $\beta = \dfrac{q}{cL}$

The general behavior of the solution in equation [9a] is shown correctly in Fig. 2 of Lewis and Milne's paper. However, equation [9] of their paper would be represented by a curve concave with respect to OX of Fig. 2 and asymptotic to a line making a positive intercept with OT. The initial rate of advance is β (i.e., q/cL), and the rate decreases toward the value α/k (i.e., $q/(b+c)L$). Thus the final rate of advance is $c/(b+c)$ times the initial rate. This is in contrast to the deduction by Lewis and Milne that the initial rate is twice the final rate. Equation [9], in fact, is consonant with an initial rate of zero.

J. R. PHILIP and G. A. MCINTYRE

Respectively, research officer, CSIRO, regional pastoral laboratory, Deniliquin, N.S.W., and principal research officer, section of mathematical statistics, CSIRO, Canberra, A.C.T., Australia.

*Equation numbers adopted are those of reference. Where the original equation has been amended, the suffix "a" has been added. Thus equation [8a] is a revised form of Lewis and Milne's equation [8].

A Century of Progress in Farm Housing and Storage Structures

By W. G. Kaiser
FELLOW ASAE

YOU don't have to travel far or delve deeply in musty volumes to get a picture of what farmhouses and farm storage structures were like a hundred years ago. Some of the structures erected then are still in use. In fact, some of the farmhouses and storage buildings being constructed today in some of the less productive farming areas differ very little in size and function from those built a century ago. I do not wish to imply by this statement that little progress has been made during the past century. Actually, progress has been amazing.

Farm buildings erected 100 years ago were small, measured by today's standards. Farm homes mostly had only from two to four rooms. The present kitchen of the house on my farm in northern Illinois once constituted a complete farmhouse. That was about 75 years ago, as near as I can determine. It had two rooms on the first floor and an attic which was used as sleeping quarters. The attic was reached by a ladder through a hole in the attic floor. The sidewalls of the attic extend only about 2 ft above the floor and contain several windows consisting of horizontal slots in the wall just under the eave. These openings are covered by glass about 4 in high and 18 in long.

Barns and other farm buildings erected 100 years ago were also relatively small, but the invention of the reaper and other farm machinery brought about the need for larger buildings to house the increased production of crops and livestock. To meet this need, larger and larger farm buildings were erected, usually of heavy timber frame construction.

PROGRESS IN FARMHOUSE CONSTRUCTION

By the turn of the century another definite trend in farm building construction was occurring. The heavy timber construction was giving way to balloon construction using built-up framing. The local builder had more and more to do with farm construction, particularly the farmhouse. The farmer perhaps felt that the building of a house required a bit more skill than he possessed. However, he and his wife continued to be their own architects, determining the general plan and style of home to be built.

Typical of the houses built 50 years ago is a house built by my father on his farm in northwest Iowa in 1902. Our family had become too large for the old house which, although some 30 or more years old, was in a fairly good state of preservation. In many respects it was not unlike present frame construction, except that the walls had been heavily backplastered with a mixture of sand, lime and clay, almost filling the space between the inside plaster and the outside sheathing.

It was a T-shaped house with the kitchen and dining room in the stem of the T, and the parlor and master bedroom across the end on the first floor. Upstairs there were three bedrooms, one for the four boys and the hired man, one for the four girls, and a spare bedroom for company. There was a rather commodious closet at the head of the stairs, the only built-in clothes closet in the house. It served its purpose nicely as we weren't burdened with an overabundance of wearing apparel — we wore most of it.

Plumbing was completely lacking, and running water in the house was limited to that which we poured down the drain in an improvised washstand in the kitchen. The water disappeared somewhere under the kitchen which was unexcavated. There was a cistern and a well about 30 ft deep near the house. The former provided water for laundry and bathing purposes and the latter for drinking and cooking. The cistern held about 100 barrels. It was circular in shape. The walls were of portland cement plaster applied directly against the earthen walls in two coats to a total thickness of about ¾ in. A brick arch closed the top. We were never without water — soft water in the cistern and hard water in the well.

Heating of the house in winter was confined to two rooms — a corncob and wood-burning cook stove in the kitchen and a hard coal baseburner in the dining room, which served both as dining room and living room. The parlor was seldom opened in the winter or for that matter in the summer and then only on "state" occasions.

There were three long narrow porches and a stoop. Each had turned posts and were resplendent with the brackets, spindles and other ornamental affectations of the era. These were the pride of our family and the envy of our neighbors. There were large elaborate brackets in each gable of the house.

Every farmhouse of class and distinction early in the century had a large window in the front of the house with colored leaded glass in the top section. The window was the equivalent of the present-day picture window. There was this difference. In the old days the window itself was the attraction, whereas the view seen through the picture window is now featured. Our house had two such windows, on the side facing the highway to the east.

American-made portland cement was just coming onto the market in northwest Iowa in 1902 when the house was built. It was used to construct the floor in the basement, which was built under part of the house, and for casting large concrete block for the exposed part of the foundation wall—that part from the ground up to the sills, a distance of about 2 ft. These units, or block, were cast in plank molds made by the stone masons. The block were large—about 2 ft long, 1 ft thick and 6 in high. They were solid, weighing about 145 lb each. They were laid in red mortar which has long since faded to a pale pink. In other respects, the basement wall of stone masonry and concrete block is seemingly in as good condition now as when built 50 years ago.

An address presented before a meeting of the American Society of Agricultural Engineers at Chicago, Ill., September, 1952, held in conjunction with the Centennial of Engineering Convocation.

The author—W. G. KAISER—is assistant director of promotion, Portland Cement Association, a past-president of ASAE, and the recipient of the Cyrus Hall McCormick Medal awarded in 1946 by ASAE.

I would like to tell of a farmhouse in central Iowa which recently underwent transformation. It is occupied by a young farmer, his wife and their young daughter. They had the desire and the know-how to design and build a modern farm home.

There was an old frame house on the farm when they moved onto it three years ago. This house had already undergone four remodeling operations in the 90 years since the first part of it was built. The house originally was a small frame structure with two rooms downstairs and two upstairs under a sloping roof.

When the couple moved into the house, they found a building structurally sound and of ample space but far from modern as measured by today's standards. It contained none of the modern conveniences.

The old house was placed on a permanent foundation providing a full basement. In its new location, the house has a commanding view to the south and to the east with public roads about 100 yards distant in both directions. The house is approached from the road to the south by a long curving drive. The ground slopes to the south and east of the house, permitting a grade entrance to the garage which is in the east end of the basement. In front of the garage parking space for several cars has been provided.

The farm service buildings are to the north and east of the house. In this area, prevailing winds are westerly, thus the house is mostly free of barnyard odors. There is a service drive to the farm buildings from the road along the east side of the property. A lawn and a garden occupy the space between the house and the service buildings, the nearest of which is a laying house about 200 ft distant.

The house has 7 rooms and 1½ bathrooms. There are 3 bedrooms and a modern bathroom on the second floor. All bedrooms have cross ventilation and are furnished and decorated in the modern mode. On the first floor are the kitchen, dining room, living room, the farm office or reading room and the wash room. The kitchen is to the northeast with windows over the sink looking toward the farm yard. The kitchen is modernly equipped with a two-compartment sink, range, refrigerator and ample cabinets. Space has been provided for the installation of an electric dishwasher at some later time. Bottled gas is used for the range; the other appliances are operated by electricity. The dining room is to the south of the kitchen, with large windows to the east and south. There is a screened porch to the east in which meals are frequently served in hot weather. The basement garage is under the east porch and the dining room. There is a large living room in the southwest part of the house with a fireplace in the west end. The front door is in the south wall near the east end of the room. A curved walk leads to the parking area and drive. In most respects the dining room and the living room find their counterpart in modern city homes.

In the northwest part of the house is the farm office and reading room. This room can be reached from the living room and from the service hall. The farm office is a most attractive room with built-in cabinets and shelves for books and farm records. A large plate glass window in the north wall offers a full view of the farm service yard and buildings from the office.

It is the rear service hall that makes this house of special interest to planners of modern farm homes. It runs along the east end of the north wall. The rear or service door has an east exposure. This door is used in going from the house to the service buildings, or vice versa. As you enter the hall, there is a wardrobe-type closet to the right for work clothes. To the left is a door to the kitchen, a door to the basement and a door to a washroom with lavatory and toilet. The farm office is at the end of this hall and can be reached from the farm yard without going through other rooms of the house. The washroom is conveniently located in that workers can clean up as they come into the house, or, in the event a shower is desired, facilities for this are in the basement, reached by the stairway opening into the same service hall. The stairway to the second floor runs parallel to the hall. Thus anyone coming in from the service yard can reach the upstairs bedrooms without passing through other rooms.

The house is heated by a furnace in the basement with forced-air circulation, controlled by a thermostat. Running water is provided by electric pump and pressure tank, automatically controlled. Electricity is provided by high line. This farm home has all the conveniences and facilities of a modern city home, yet it has been designed to function as a farm home and does so in a highly satisfactory manner.

Many of the farm homes being built today are new from the ground up—not old structures that have been remodeled. These new houses are frequently as up to date in every way as the modern city home. Both the modern farm and the modern city home use the same type of construction, the same kind of construction materials and contain the same

Pictured here are typical examples of a century of progress in farm housing and farm storage structures, one significant fact of which, incidentally, is that much of this progress is due to the application of engineering

kind of labor-saving appliances and equipment. They differ from each other only in that the farm home is designed to provide the conveniences and facilities required for farm living at its best, such as those built into the remodeled old farm home just described.

In the interim since my father built his house 50 years ago, many new construction materials and new applications of materials have been perfected, and continue to be developed and perfected.

While many of the basic construction materials employed 50 years ago are still in use, there have been so many new materials developed since then that it would be possible to build a house today of materials none of which were available at that time.

FARM STORAGE BUILDINGS

What are some of the developments in farm storage structures during the last 100 years? On livestock farms it has been common practice to store feed and forage either in the same building with the livestock or in a building near by for convenience in feeding. This was good practice in the past and is good practice today. On grain farms and on mixed livestock and grain farms it has been the usual practice to erect separate structures — granaries and farm elevators for the storage of grain.

My recollection of the early granaries, around 1900, is of frame buildings usually one-story high supported about one foot above ground on sills set on a number of large stones. As time passed, the stones sunk deeper and deeper into the earth under the weight of the building and its contents. Eventually, the floor joists were only a few inches above the ground. Then rats moved in, burrowing into the earth and gradually closing off the open space altogether. At about this stage, the rats gnawed holes through the wood floors into the bins above. Grain flowed through these holes in a self-feeder arrangement. Under these favorable conditions, the rat population increased at a very rapid rate.

Grain was put into the bins at threshing time by hand shoveling from the wagon boxes in which we transported the grain from the thresher. Each grain bin had a small outside window opening about 2 ft square and 8 ft above the floor through which the grain was shoveled or scooped. Eight feet was about as high as a man could shovel while standing in a wagon box.

My father built a new granary in 1900. It was one of the first in the locality to be built with a central driveway and with bins for grain on either side. The granary was a big improvement over the old building with outside openings. Now we could fill the bins by shoveling over the bin walls, a much larger target than the small openings in the walls of the building it replaced.

A few years later, my uncle, who lived on an adjoining farm, erected an even more modern grain storage building. His granary had a central driveway in which he installed a mechanical elevator to carry the grain from a pit in the floor of the driveway to a cupola or a head house, where it was distributed by spouts to bins on the first and second floors. At threshing time, this homemade elevator did the work of three men with shovels.

Along about this time (1904), portable farm elevators appeared on the market. They took much of the backache out of the job of shoveling at threshing and corn-picking time. Portable elevators were generally run by horse power as the small gasoline engine had not yet come into general use as a farm-power unit.

Stationary elevators suitable for installing in farm granaries were also coming into use about this time. They exerted a marked change in the design of grain-storage buildings. Cribs for corn and bins for grain were combined in one building to make fullest use of the elevator. With an elevator, the height to which the walls might be built was no longer limited to the height a man could shovel from a wagon. The sidewalls could be built much higher than formerly. A height of 16, 18 and 20 ft from foundation to plate was common. The space over the driveway could be used for storage, since it could be reached by the elevator. It became common practice to construct bins over the driveway. This location made it possible to remove grain from the bins by opening gate valves in the floor. Cribs for the storage of ear corn were commonly placed on either side of the driveway.

At first these farm elevators were mostly of frame construction. However, there soon appeared structures of the same general design built of clay building tile or clay block as they were then called. These were followed a few years later by concrete-stave construction. The concrete staves used for this purpose were slabs of concrete made in a local products plant and erected by builders who specialized in this type of work.

With the advent of the modern farm elevator, concrete floors gradually replaced the wood floors common in the earlier grain-storage structures. Rat control became much easier when these pests were thus deprived of their choice hiding places.

In recent years, a great deal of attention is being given to artificial drying of grain and ear corn in storage. This practice is bound to have a definite, perhaps radical, influence on the future design and construction of storage structures. Controlled ventilation and drying may supersede natural drying. Up to now, artificial drying has been applied mainly in existing structures. Field shelling of corn, another probable development, would most certainly necessitate providing means for artificial drying of corn to reduce its moisture contents to a point safe for bin storage. The field shelling method of harvesting corn would make the present slatted corn crib as obsolete as the horse stable. The immediate future doubtless will witness great changes in the methods of harvesting and storing of grain on the farm.

Farm storages for dried forage crops—hay, straw, fodder —has progressed about as follows:

1 Storage in the open—outdoor stacking—100 years ago.

2 Loose storage in hay sheds or barn lofts—50 years ago.

3 Storage of bales or chopped material in lofts, storage sheds, hay keepers — present.

Almost all types of storage buildings for dry forage crops can be seen in use today in most agricultural areas. The type of storage used on any farm is governed by the method of harvesting, the storage facilities on the farm, the type of farming practiced and other factors. The farmer having a large barn with loft space adequate for storage of loose hay will most generally use the same storage facilities in the event he changes his hay-harvesting methods to baling or chopping. Most of the existing barns designed for storing of loose hay are underdesigned for supporting the increased loads of baled and chopped hay. *(Continued on page 46)*

NEWS SECTION

Nominations for 1953-54 ASAE Officers

THE Nominating Committee of the American Society of Agricultural Engineers—F. J. Zink (chairman), F. R. Jones, and Hobart Beresford—has placed in nomination the following members of the Society for the various elective offices to be filled at the next annual election of officers which will be conducted by letter ballot in February

NOMINEE FOR PRESIDENT

EDWIN W. TANQUARY is a native of Canton, Ill., who studied mechanical drawing in high school, and in 1920 entered the pattern shop at the Canton plant of the International Harvester Company. Foundry work soon proved more interesting and he enrolled in a student course in the foundry, studying foundry engineering by a correspondence course. In 1924 he was promoted to assistant foreman of grey iron and malleable foundries. Two years later he returned to the pattern shop as assistant foreman to assist in a program of foundry pattern modernization. He graduated into the engineering department in 1928 to work on tillage equipment and served there in increasingly responsible capacities until 1938.

EDWIN W. TANQUARY

Next he was moved to the Chicago headquarters of the Company as engineering specialist, to work on special assignments, field complaints, tillage implements, hydraulic systems, and related matters.

Since 1943 he has been special engineer in the Chicago headquarters, responsible for coordinating the work of the implement and farm tractor engineering departments. He was also named to represent the Company on farm implement engineering on the Engineering Advisory Committee of the Farm Equipment Institute. His work as a member of that committee resulted in his subsequent selection as its chairman, a position he has held since 1945.

Work with the FEI engineering committee developed an interest in farm safety and resulted in a number of articles and talks covering the interest on the part of design engineers and the work done in farm equipment design to promote safer operation of farm equipment.

Elected to membership in the Society in 1946, he contributed to the development and revision of ASAE Bulletin No. 44, entitled "Farm Tractors Built or Convertible to ASAE Standard Dimensions," and to the Society's Standard: Application of Hydraulic Remote Control to Farm Tractors and Trailing Type Farm Implements.

He served as vice-chairman of the ASAE Power and Machinery Division in 1949-50, succeeding to the chairmanship for the following year. He is a member of the Steering Committee of the Division. He is also a member of the technical board of the Society of Automotive Engineers.

ASAE Meetings Calendar

January 16—IOWA-ILLINOIS SECTION, American Legion Club Room, 829 16th Ave., East Moline, Ill.

January 20—MINNESOTA SECTION, University Farm Campus, University of Minnesota, St. Paul, Minn.

January 23 and 24—NORTH CAROLINA SECTION, Reddick Auditorium, Raleigh, N. C.

February 9-11—SOUTHEAST SECTION, Roosevelt Hotel, New Orleans, La.

February 14—MICHIGAN SECTION, Edison Boat Club, Detroit, Michigan.

February 27 and 28—PACIFIC COAST SECTION, California Polytechnic College, San Luis Obispo, Calif.

March 7—OHIO SECTION, New Idea Farm Equipment Co., Coldwater, Ohio

April 9—OKLAHOMA SECTION, Oklahoma A. & M. College, Stillwater.

April 10 and 11—SOUTHWEST SECTION, Oklahoma A. & M. College, Stillwater, Okla.

April 23 and 24—PENNSYLVANIA SECTION, Agricultural Engineering Bldg., Pennsylvania State College, State College

May 1 and 2—VIRGINIA SECTION, Natural Bridge Hotel, Natural Bridge, Va.

June 15 to 17—46TH ANNUAL MEETING, Hotel William Penn., Pittsburgh, Pa.

December 7-9—WINTER MEETING, Edgewater Beach Hotel, Chicago, Ill.

NOTE: Information on the above meetings, including copies of programs, etc., will be sent on request to ASAE, St. Joseph, Michigan

NOMINEES FOR VICE-PRESIDENT

JAMES W. MARTIN grew up in Kansas, graduated from Kansas State College with a bachelor's degree in electrical engineering in 1933, and went to work with the John Deere Plow Co.

Here his contacts with agricultural engineering developed his interest to the point that after a few years he returned to his alma mater to complete requirements for a bachelor's degree in agricultural engineering in 1937. Then he went on to Iowa State College to complete requirements for a master's degree in agricultural engineering in 1938. After a year of research work on farm tractors at the Illinois Agricultural Experiment Station, he was recalled to Kansas State College as instructor in agricultural engineering, and advanced to assistant professor in 1942. That same year he was called to war service in the armed forces. Returning to Kansas State

NOMINEES FOR VICE-PRESIDENT

JAMES W. MARTIN

FRANK W. PEIKERT

NOMINEES FOR COUNCILOR

HARRY DEARING, JR.

JAMES L. STRAHAN

as associate professor in 1946, he later that year accepted appointment as professor and head of the agricultural engineering department at the University of Idaho. Continuing progress in the department under his direction resulted in its professional curriculum being accredited by the ECPD in 1948.

A member of the Society since 1939, he has served on its committees on professional registration, course content, and cooperation with ASEE and ALGCU; and on the advisory committee to the USDA Division of Farm Machinery. He has also contributed several papers published in AGRICULTURAL ENGINEERING. He is also a member of the American Society for Engineering Education, Gamma Sigma Delta, Sigma Xi, and the National Society of Professional Engineers. He is registered as a professional engineer in Kansas and Idaho.

FRANK W. PEIKERT is a native Californian whose professional progress in agricultural engineering has taken him to many of the agricultural areas of the United States.

Following his graduation in agricultural engineering at the University of California in 1933, he obtained a research fellowship at Iowa State College and received his MS degree there in 1934. Further steps in his career include appointments as assistant professor (1934) and associate professor (1938), University of Georgia; associate professor (1940) and professor (1941), Texas A & M College; development engineer, Goodyear Tire and Rubber Co. (1944-45); professor, Michigan State College (1945); professor and head of the agricultural engineering department, University of Maine (1949). The latter is the position he fills at present. It was a new department when he was appointed. He set up its professional curriculum providing training for BS and MS degrees in agricultural engineering, and developed a research program. During the first ten years of his professional career his work was mostly in the field of power and machinery. Since 1945 he has been more closely identified with soil and water control, and especially sprinkler irrigation. Since 1949 he has been active in the work of the New England Farm Electric Service Committee.

A member of the Society since 1934, he has been active on several of its committees and at various times chairman of its committees on relations with vocational education, ASAE paper awards, student branches, curriculum, graduate studies, and sprinkler irrigation standards. At the same time he has been active in the several sections with which he has been associated in turn in his various locations, and has presented papers at annual and section meetings. He is also a member of the American Society for Engineering Education, Phi Kappa Phi, and Sigma Xi.

NOMINEES FOR COUNCILOR

HARRY DEARING, JR., is a native of Alabama, and a 1932 graduate of Alabama Polytechnic Institute, with a bachelor's degree in architectural engineering. During his college years he used his summer vacations to gain experience in work with contractors, surveyors, newspapers, and architects. His undergraduate work earned election to Scarab, honorary architectural society, and to Tau Beta Pi. Following his graduation he gained a variety of "in training" experience in surveying, with the U.S. Coast and Geodetic Survey; in farm house design, with the Civil Works Administration and Alabama Polytechnic Institute; and as estimator and draftsman with a building materials dealer.

In April, 1935, he was appointed assistant agricultural engineer in the Alabama Agricultural Extension Service. There his work until 1938 was largely in the architectural design of county extension office buildings and similar structures. There he was promoted to extension agricultural engineer and assigned to work on farm structures. Since 1943 he has been agricultural engineer with the Tennessee Coal and Iron Division, United States Steel Co.

A member of ASAE since 1935, he served as secretary-treasurer of the Southeast Section, 1947-49, and as its chairman in 1950. He has also contributed to programs and committee work of the Farm Structures Division.

JAMES L. STRAHAN earned his bachelor's degree in agriculture in 1912, and his master's in 1913 at Cornell University. From that base he broadened his professional experience with teaching rural engineering at Cornell, extension work in rural engineering in Massachusetts, commercial ventilation and agricultural engineering with the Louden Machinery Co., private agricultural engineering practice, engineering with the Farm Security Administration, agricultural engineering with the Flintkote Co., and since 1946 his present position as technical director for the Asphalt Roofing Industry Bureau.

A member of ASAE since 1919, he was elected to the grade of Fellow in 1944. His service in the Society includes a term as vice-president in 1928-29, chairman of the Farm Structures Division, 1929-30, numerous committee assignments, and technical contributions on ventilation and other farm structures matters. He is a member of the American Society of Heating and Ventilating Engineers, the Better Farm Buildings Assn., and the Farm Structures Institute; and a licensed professional engineer in New York state.

NOMINEES FOR NOMINATING COMMITTEE

R. H. DRIFTMIER, head, agricultural engineering department, University of Georgia

B. P. HESS, agricultural engineer, industrial sales dept., Westinghouse Electric Corp.

PRICE HOBGOOD, agricultural engineering department, A. & M. College of Texas

C. J. HURD, owner, Hurd Farm Electric Supply, Spokane, Wash.

E. G. MCKIBBEN, director of agricultural engineering research (BPISAE), U.S. Department of Agriculture

R. R. POYNOR, farm practice research, International Harvester Co.

(News continued on page 40)

Snapshots made during the dinner session of the 1952 meeting of the ASAE Pacific Northwest Section at Corvallis, Ore. *(Left)* Retiring Section Chairman Jesse E. Harmond (right) presents the gavel to the new chairman, Karl T. Dimmitt. *(Right)* ASAE President Ivan D. Wood presents check to one of the winners, Robert Best (right), of the Section's student paper awards

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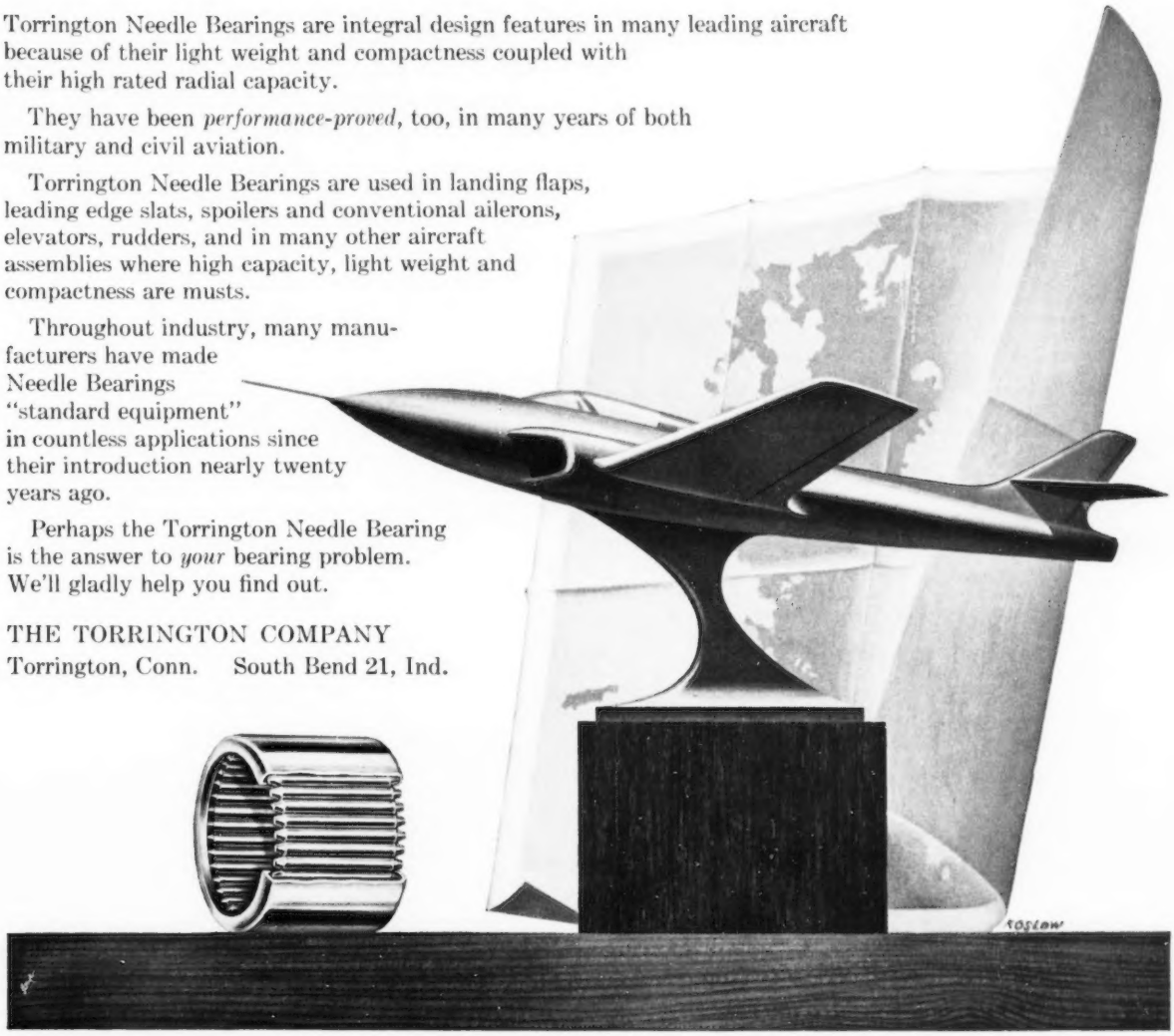

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NEWS SECTION *(Continued from page 38)*

ASAE Winter Meeting Grows

A NEW record attendance of nearly 1100 members and visitors registered for the ASAE Winter Meeting, at Chicago, Dec. 15-17. Reaction to the new setting at the Edgewater Beach Hotel was somewhat mixed but generally favorable. Meeting rooms proved adequate for the attendance. Satisfactory acoustics, with the help of amplifiers, enabled speakers to be heard by the whole audience.

Early arrivals were more numerous than usual, more than 100 being registered Sunday afternoon. Registration was heaviest on Monday morning, and sessions throughout the day were especially well attended.

Isolation from the "Loop" may have contributed somewhat to attendance at evening sessions, but strong and genuine interest was evident in the numerous committee and special group dinner and after-dinner discussions.

Wide corridors and ample lounging capacity encouraged professional sociability and the spontaneous man-to-man exchange of information which has become one of the major values of the meeting.

The contribution of agricultural engineers in general, and agricultural engineering research in particular, to the improvement of farm equipment, was re-emphasized in the annual dinner sponsored by the Research Committee of the Farm Equipment Institute for public service agricultural engineering department heads and research men. Combined and intermingled host and guest groups numbering approximately 200 heard R. W. Trullinger (past president of ASAE), chief, Office of Experiment Stations, summarize the record of "Cooperative Responsibilities in Agricultural Research." A panel contributing supplementary remarks on the subject from a variety of viewpoints included E. G. McKibben, director of agricultural engineering research, USDA; A. W. Farrall, Michigan State College; A. E. W. Johnson, vice-president and director of engineering, International Harvester Co.; and W. J. Fisher, president, Farm Equipment Institute.

Additional cooperative interests were emphasized in the Grassland Farming program held Thursday, December 18, sponsored by the Joint Committee on Grassland Farming.

Representatives of the ASAE Chicago Section again operated the registration desk, provided assistance and facilities for the Public Relations Committee, and handled other important activities contributing to the success of the meeting.

Dairy Engineering Conference

"ENGINEERING — the Key to Profit" will be the theme of a conference on dairy engineering at Michigan State College, February 25 and 26. Sponsor of the conference is the agricultural engineering department of the College in cooperation with its dairy department.

H. L. Mitten, Jr., of the Creamery Package Co., is to preside at the first session. Following opening remarks by A. W. Farrall, Michigan State College, the program will proceed directly to consideration of time-and-motion studies. Scheduled contributors are Carl W. Hall, Michigan State College, and A. W. Bayer, General Ice Cream Co. Cleaning equipment for the dairy plant will be the second topic on the morning program, with contributions by R. F. Holland, Cornell University, and John Perry, National Dairy Products Corp.

Four subjects to be presented in the afternoon session are "Progress in Sanitary Standards for Dairy Equipment," by E. H. Parfitt, Evaporated Milk Ass'n.; "Milk and Metals," by A. H. Wakeman, Creamery Package Mfg. Co.; "Floor and Construction Materials," by a representative of the Kraft Mfg. Co.; and "Air Conditioning of the Dairy Plant," by a representative of the Carrier Corp.

Featured speaker at an evening banquet will be H. F. Judkins, director, National Dairy Products, Inc. He will be introduced by A. W. Farrall, chairman for the evening.

Refrigeration is marked for special attention the second morning. Contributions listed are "Principles Underlying the Design of a Balanced Refrigeration System," by Leon Beuhler, Creamery Package Mfg. Co.; "Problems Encountered in the Care and Lubrication of a Refrigeration Machine," by a representative of the Frick Co.; "Savings Effected Through Efficient Use of Condenser Water," by Dale Webber, Heatherwood Dairy; "Elimination of Frost Difficulties in a Low-Temperature Refrigeration System," by a representative of the York Mfg. Co.; and "How to Obtain Maximum Efficiency from a Continuous Freezer," by Gil Wyman, Cherry-Burrell Corp. Carl W. Hall is to preside.

"Water Treatment for the Dairy," by M. F. Obrecht, Michigan State College; "Know Where Your Btu's Are Going," by L. W. Thomson, University of Wisconsin, and "How Truthful Is Your Temperature Control Equipment," by a representative of Taylor Instrument Co., are listed for the closing session.

Official Statements on USDA Transfers

IN OCTOBER the Secretary of Agriculture placed responsibility for conducting all USDA research in soil and crop management, and in water management on farms related to crop production, in the Agricultural Research Administration. In November the research in these fields being conducted by the Soil Conservation Service was transferred to the Bureau of Plant Industry, Soils, and Agricultural Engineering. Therefore, at the request of AGRICULTURAL ENGINEERING, the chiefs of SCS and BPISAE have supplied the following statements setting forth their concepts of the future role of agricultural engineering in soil conservation:

Dr. Robert M. Salter, chief of the SCS has replied as follows:

"Agricultural engineering has been the basic specialty of a dominant number of technicians in the SCS ever since the soil conservation program began. I believe that the soil and water problems still remaining on the farm lands of this nation demand more — not less — attention by the agricultural engineering profession.

"Agriculture faces the problem of supplying the basic demands of a fast-growing nation from a more or less fixed acreage of cropland. The soil conservation job is to build up and maintain our soil resources in condition to efficiently meet demands as they arise.

"The purpose of the SCS program is to furnish farmers the on-site technical assistance they need in solving soil and water problems on the land they operate. On most farms the conservation job involves a combination of such factors as controlling erosion, rebuilding eroded and depleted soils, conserving moisture for plant use, providing for drainage or irrigation, and reducing flood damages — all in proper relation to each other.

"The efficient solution of such complex problems requires a variety of technical skills—soil science, agricultural engineering, agronomy, hydrology, etc. I believe that specialists in the various fields should occupy roles of comparable responsibility, with the respective specialists pulling their full share of the load on a team built around the specific problem to be solved. It is in this role that I conceive agricultural engineering as making a vital contribution in a speeded-up soil conservation program.

"The recent realignment of research responsibilities in USDA, I believe, promises expanding opportunities for agricultural engineers to contribute to soil conservation through research. SCS research in hydrology, sedimentation, and irrigation and drainage undoubtedly can be strengthened under our new arrangements, with a resulting increase in the need for agricultural engineering skills.

"The BPISAE, in its fields of responsibility, is assigned the job of making its research serve the needs of the SCS program. The SCS is now in the process of developing with BPISAE working mechanisms for meeting these needs. State agricultural experiment stations will be invited to participate in the development and operation of those mechanisms, and agricultural engineers at state stations will have opportunities to contribute.

"I believe that the agricultural engineering profession now has a better opportunity than ever to help solve the difficult soil and water problems that are confronting farmers throughout the nation."

Following is the reply of Dr. A. H. Moseman, chief of the BPISAE:

"The recent realignment of research responsibilities in USDA provides one of the most challenging opportunities yet presented for agricultural scientists to advance soil conservation through research. The impact of this action goes far beyond the mere transfer of certain research projects from one agency to another.

"The BPISAE now has an increased responsibility for developing research programs which will serve more adequately the needs of SCS Operations. We recognize that this responsibility is not limited to the research projects transferred to the Bureau, neither is it limited to any one division or any one group of divisions in the Bureau. We are anxious to see that the current findings from all of our research projects in soils, field crops, agricultural engineering, and horticultural crops, pertinent to soil and water conservation, are readily available for use in the SCS program.

"The engineering phases of soil and water conservation cannot be isolated and handled separately in our research on crop and soils problems related to conservation. The soil and water problems confronting farmers on their land certainly are not confined to boundaries of scientific specialties. In fact, the unsolved problems are the more complex ones—the ones that interrelate several specialized fields. In recognition of this, we have in recent years been organizing our research projects in such a manner that the skills of all needed specialties can be brought to bear simultaneously for the efficient and effective solution of problems.

"Agricultural engineers in the Bureau will be assigned important roles in meeting our new responsibilities. These roles will be primarily as members of teams of specialists so organized that each scientist can make maximum contributions depending on his skills and experience. We shall continue to select the leaders of our programs on the basis of ability. A man's *(News continued on page 42)*

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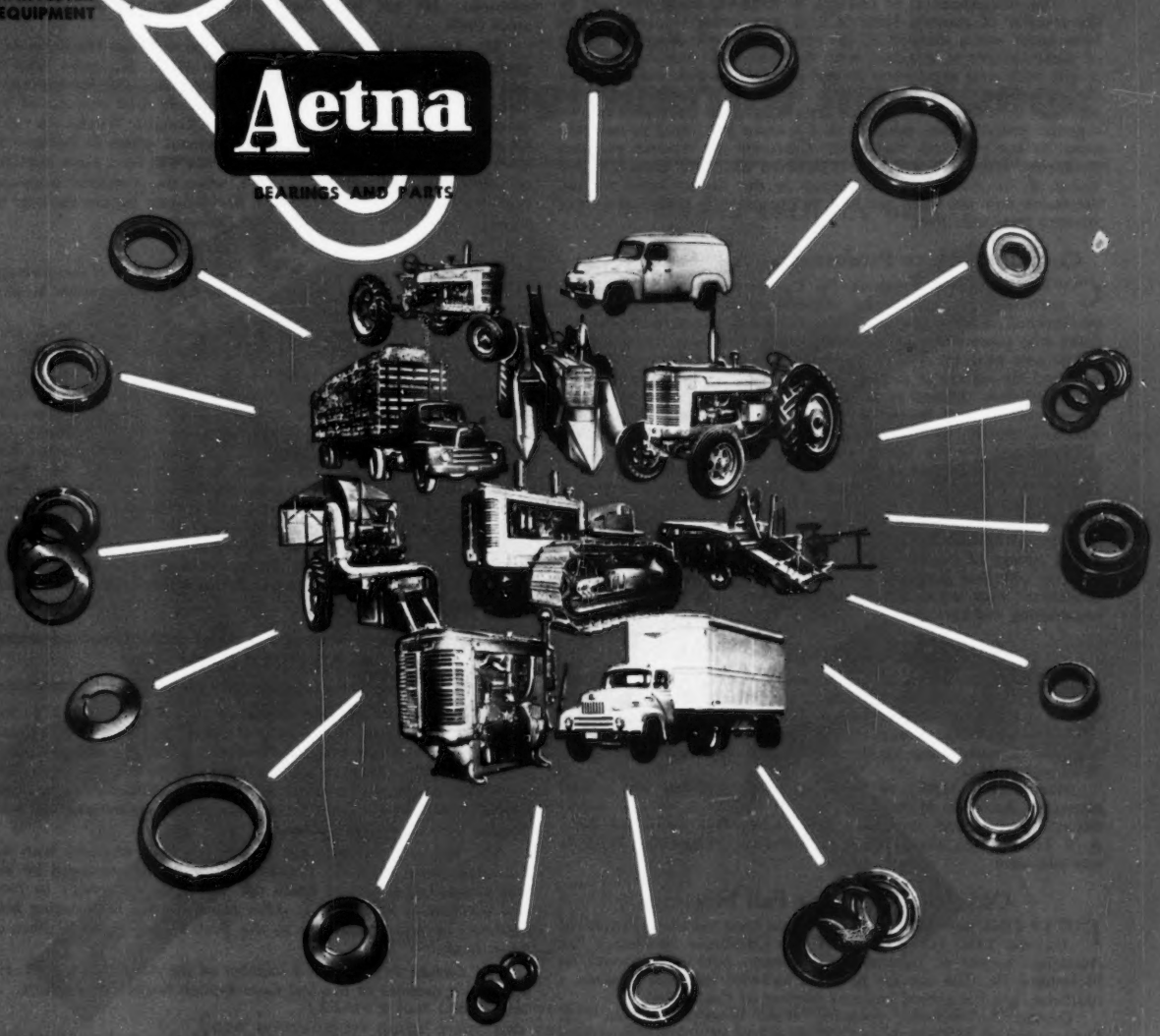

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NEWS SECTION (Continued from page 40)

field of specialized training will not be a major factor in either enhancing or retarding advancement.

"The reorganization of research in BPISAE, made necessary by the transfer of projects from SCS, is now being considered. We have under way a study of all the research projects involved. Many of these involve cooperation with the states and will be reviewed jointly with state experiment station personnel before making major changes. This study may take as long as six months to be as thorough as it needs to be. Only after it has been completed can we organize our complete program in a manner best fitted to meet the needs of the problems that exist. Currently the research program transferred from SCS will be administered under the general supervision of the Soils Research Group in the Bureau until we can determine how the work can best be organized to meet our greater research responsibilities."

Cornell to Have Professional A-E Curriculum

CORNELL University, Ithaca, N. Y., has set up a special 5-year curriculum in agricultural engineering and will grant a new professional degree—bachelor of agricultural engineering—to students who successfully complete the work. The joint announcement of the new program is made by the deans of the college of agriculture and the college of engineering, following approval of the University trustees. Several years of planning have gone into the development of the new course of study which will maintain the high standards required by both colleges.

Applicants for the 5-year course will be accepted at Cornell for the first time in the fall of 1953, and they must satisfy the entrance requirements of both the colleges of agriculture and engineering. Students will enroll in the agricultural college for the first 4 years, but during that time they will also be taking courses in the colleges of engineering and arts and sciences. The fifth year will be spent in the college of engineering which will grant the degree.

The complete program is under the supervision of a faculty committee with equal representation from both the colleges of engineering and agriculture.

Sprinkler Irrigation Association

AT ITS annual meeting in November the Association of Sprinkler Irrigation Equipment Manufacturers voted to change the organization name to Sprinkler Irrigation Association.

Joseph T. King, counsel to the organization, was named secretary and is maintaining his office at 1028 Connecticut Ave., N.W. Washington, D.C.

Marion H. J. Miller, of Spokane, Wash., president and general manager, Anderson-Miller and Poston Mfg. Co., is the newly elected president of the Association, succeeding Crawford Reid. A. S. Marlow, Jr., president, Marlow Pumps, Ridgewood, N. J., is vice-president.

Oklahoma Section's Fall Meeting

FORTY-ONE agricultural engineers and their associates registered for the 1952 fall meeting of the Oklahoma Section of the American Society of Agricultural Engineers held at Stillwater on November 28. The one-day program included technical sessions, a luncheon, and the annual business meeting of the Section.

During the morning program, Elmo Baumann of the U.S. Department of Agriculture and Oklahoma Agricultural Experiment Station, spoke on the topic "Impervious Soil Problems." Leonard G. Schoenleber, agricultural engineer with the U.S. Department of Agriculture and the Oklahoma Agricultural Experiment Station, described improvements and modifications being made in the castor bean harvester under development, and told of castor bean hulling studies being made with their experimental castor bean huller. Roy E. Hayman, agricultural engineer with the Public Service Co. of Oklahoma, explained design and construction of a new type of pole frame livestock and hay storage structure developed by his company. The final topic for discussion on the morning program was handled by R. E. Jaquier of Oklahoma City on the subject "Training Engineers for the Farm Equipment Industry."

The "where" and "how" phases of irrigation in Oklahoma were the main topics of discussion during the afternoon technical program.

At the business session of the Section, it was decided to hold the spring meeting of the Oklahoma Section one day in advance of the Southwest Section meeting to which Oklahoma will be host. Officers elected for the ensuing year included W. T. Wheeler, regional product specialist, tillage and seeding machines sales, International Harvester Co., as chairman, and G. L. Nelson, associate professor of agricultural engineering, Oklahoma A & M. College, as vice-chairman.

NEWS OF ASAE MEMBERS

ARNOLD E. W. JOHNSON was recently named a vice-president of the International Harvester Co., in charge of staff engineering activities. He has been the Company's director of engineering since 1947.

Mr. Johnson began his career with International Harvester as a draftsman at the McCormick Works in 1916. Six years later he had advanced to the position of designing engineer for harvester-threshers, and in another four years was made chief engineer of the product engineering department at the McCormick Works. In 1927, he was transferred to the Company's general offices as assistant to the manager of implement engineering, and was later made manager of implement engineering. In 1944, when the divisional organization of the company was instituted, Mr. Johnson became manager of engineering for the farm implement division.

• • •

LEWIS A. JONES retired on December 20 as chief of the drainage and water conservation division of the Soil Conservation Service, U.S. Department of Agriculture.

Mr. Jones is a native of Minnesota and a graduate of the University of Minnesota in civil engineering, in 1907. He entered the employ of the U.S. Department of Agriculture in 1909 as assistant drainage engineer in the Office of Experiment Stations. Later he had responsible charge of surveys and designs of several important drainage systems, including Kootenay River project in Idaho, Cypress Creek in Mississippi, and the Luxapallila in Alabama. Following overseas service as a captain in World War I, Mr. Jones returned to his work as a drainage engineer in the USDA and was the first chief of the drainage division of the Bureau of Agricultural Engineering when it was formed in 1931. He continued as chief of this work in research after the activity was transferred to the Soil Conservation Service in 1939. He has shown outstanding ability in his leadership of research projects during the last 20 years as chief of his division.

NECROLOGY

RUSSELL W. GRANBERRY, drainage engineer with the U.S. Soil Conservation Service at its regional office in Fort Worth, Texas, died in a Fort Worth hospital November 20 at the age of 47. He was born at West Monroe, La., on April 13, 1905. After graduation from Monroe High School he entered the Louisiana state normal school at Natchitoches, and later studied civil engineering for three years at Louisiana State University.

Mr. Granberry worked for a time as a civil engineer with the Louisiana State Highway Commission. He was employed by the Soil Conservation Service (then the Soil Erosion Service) in 1934 as a surveyor at Minden, La. After filling various engineering field positions he was transferred to the Fort Worth regional office in June, 1942.

Mr. Granberry had been a member of the ASAE since 1935. He was also a member of the Soil Conservation Society of America.

• • •

WILLIAM E. MEEK, president, Farm Machinery, Inc., Greenville, Miss., passed away November 25. He succumbed to exposure and exhaustion following the swamping of his hunting boat in Lake Whittington, near Scott, Miss. His hunting companion managed to get him to shore weak but still alive after more than three hours in the water, but he passed away while his companion went for help.

A native of Mississippi and a graduate of Mississippi State College, he was engaged in sales work with the John Deere Plow Co. for 6 years, and with the International Harvester for 18 years. During that time he took an active interest in the improvement of farm equipment from the standpoint of adapting it to requirements of farmers in the South. From 1945 until 1952 he was senior agricultural engineer in charge of the USDA cotton mechanization at its Delta Branch Experiment Station at Stoneville, Miss. Resigning that position, he established the dealership which he headed at the time of his passing.

A member of ASAE since 1927, he was elected to the grade of Fellow in 1942. He served as chairman of the Society's Soil and Water Division in 1942-43. He was a veteran of World War I, a member of the Episcopal Church, and a member of Rotary International. He is survived by his widow, Mrs. Roberta Mosley Meek, and two daughters, the Misses Louise and Carol Meek, all of Greenville.

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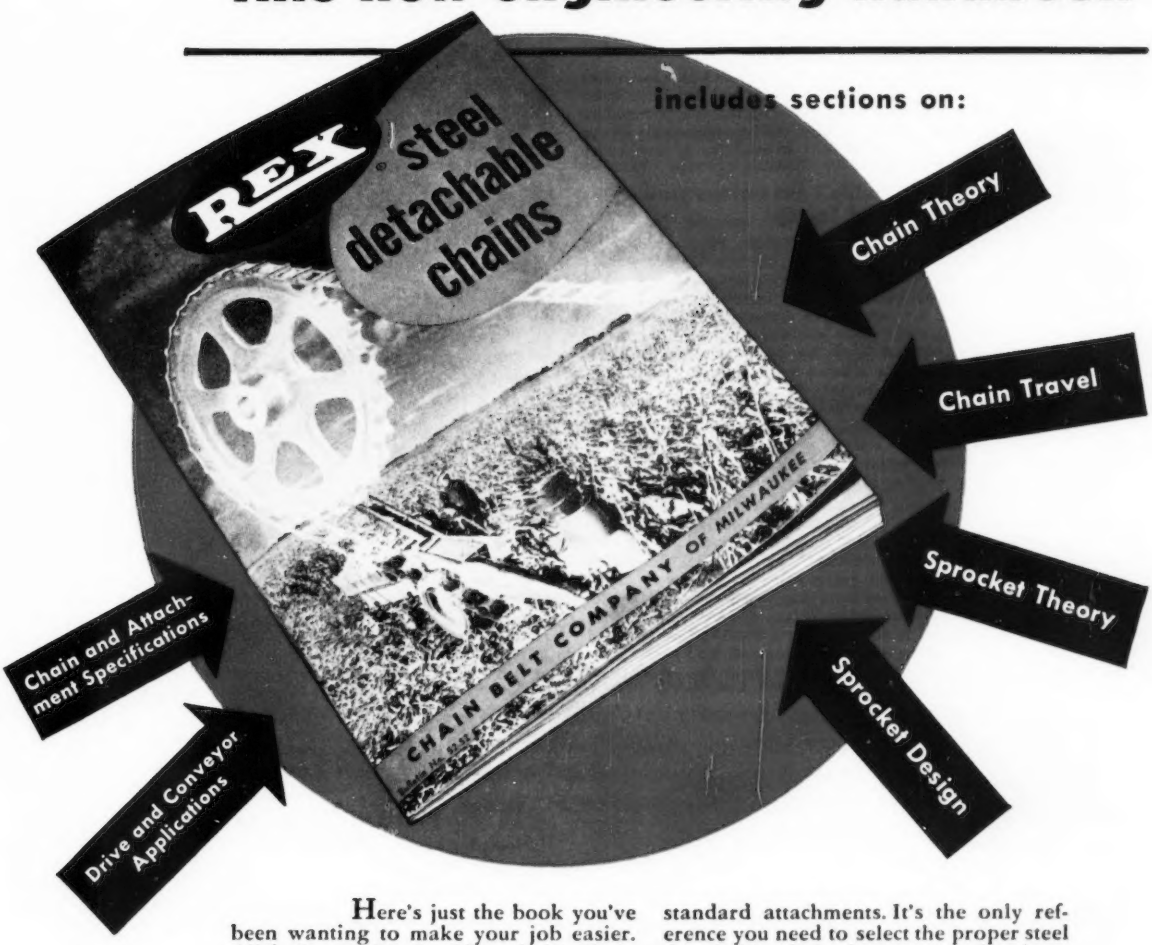

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NEWS FROM ADVERTISERS

New Products and Literature Announced by
AGRICULTURAL ENGINEERING Advertisers

Steel Link-Belt Book

Link-Belt Co., 307 N. Michigan Ave., Chicago, Ill., has a new 16-page book (No. 2403) which pictures and describes all 22 stock sizes of steel link-belt.

The booklet shows in approximately actual size all 22 stock link sizes and shapes of steel link-belt, together with 14 basic styles of attachments. Detailed specifications are given for all chains and attachments.

Also shown is the Link-Belt easy chain detacher which facilitates detaching and assembly of steel link-belt. It brings the chain links into proper position for detaching and is designed to accommodate all sizes of steel link-belt. It may be used with the chain still on the sprocket wheels. A copy of Book 2403 is available to any reader on request direct to the Company.

New Ford Tractor

Dearborn Motors Corporation, Birmingham, Mich., placed on dealers display early this month (January), the new Golden Jubilee Model Ford Tractor. This model is larger, longer, heavier and much more powerful than previous Ford tractors. Painted forest gray and vermilion red, the new tractor features all-purpose four-wheel design with automotive-type steering; built-in, live-action hydraulic system with 3-point hitch for hydraulically controlled, mounted implements; finger-tip selector lever for implement position control and constant draft control; throttle control for hairline speed adjustments; a device that permits selection of speed for operation of the hydraulic system; a new Ford overhead valve engine that develops an ample reserve of power with new efficiency and economy; streamlined tapering hood lines for better visibility in rowcrop work; and weather-proofed ignition system.

Instead of the "cavitating" hydraulic system used in previous Ford tractors, the new model introduces a solid system, completely filled with oil at all times. The hydraulic mechanism provides both implement position control and constant draft control at the flick of the selector lever. The hydraulic pump is driven directly from the engine, enabling the operator to raise and lower mounted implements at any time. Another available feature is a Selec-Trol device which directs the hydraulic power to either a front or rear-mounted tool. This permits operation of a front-mounted loader and rear-mounted tools by the same control lever, without the necessity of buying an extra hydraulic pump.

The new golden jubilee model Ford tractor

A convenient outlet at the top of the hydraulic lift cover permits mounting of a remote control valve for the operation of either single or double-acting remote hydraulic cylinders to supply power to control combines, corn pickers and other remote-control implements.

Optional equipment includes a live power take-off attachment. The completely new four-cylinder overhead valve engine has a larger cylinder bore and shorter piston stroke than the engines on earlier models. Pistons are the autothermic type, made of aluminum alloy and cam ground. Dry cast alloy cylinder sleeves are used. Features of the engine include a recalibrated carburetor, higher volume oil pump, responsive governor, precision molded alloy crankshaft, and full-flow oil filter.

Increased wheelbase of 73⅞ in and the heavier engine, give the new tractor improved front end stability and permit the use of heavier equipment. The front axle support assembly incorporates a number of mounting holes for convenience use of front-mounted equipment. A new front power-take-off simplifies the use of front end implements, such as the loader.

Over-all length has been increased to 120 in and weight to 2,510 lb. Instruments include an improved proof-meter, which registers engine speed, tractor travel speed, PTO speed, belt pulley speed and hours worked; ammeter, temperature gage, and oil pressure gage.

Three-Point Tractor Hitch

The Oliver Corporation, Chicago, Ill., has a new 3-point hitch for its "66" tractors and a specially designed 2-bottom 14-inch plow for use with it. The new hitch, designed to accommodate many rear-mounted implements, will operate with Oliver's Hydra-lectric control system or the manually operated hydraulic system. A new type floating linkage assures uniform depth for the rear-mounted tools when the tractor rolls over bumps or into holes.

New Oliver 3-point tractor hitch and mounted plow

A special drawbar permits the operator to pull drawn equipment without removing the 3-point hitch. On applications where excessive side draft is encountered on the 3-point hitch, a stabilizer bar may be installed between the lower links to maintain the implement directly behind the tractor. A special hitch support bar can replace the hydraulic cylinder to make it available for front-mounted or drawn implements. The hitch can be supplied as a factory installation on new "66" tractors, or as a package to be installed on tractors already in the field.

The new 1214 plow has ample adjustments for all plowing conditions. Raydex bottoms are standard equipment.

PTO 120-bu Manure Spreader

New Idea Farm Equipment Co., Coldwater, Ohio, has scheduled for early production a new power-take-off-driven, 120-bu capacity spreader. It is meant for large farms, feedlots, and those sections where it is often necessary to pile manure in the field when spreading is not possible due to soft or slippery ground.

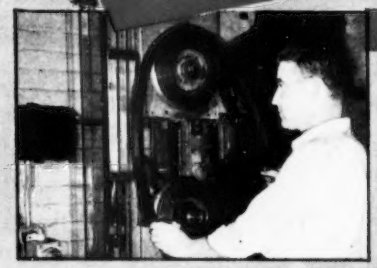
This new spreader has power take-off-driven beaters, distributor and feed. Stub axles attach to I-beam main axle. Sealed wheel hubs

The new New Idea power-take-off-driven spreader

run on tapered roller bearings. Distributor paddles can be removed without dismantling the entire unit. Enclosed gears run in oil and drive is through roller chain with slip clutch. A four-notch feed-control lever can be operated from the tractor seat. The box construction is of wood. This power take-off spreader provides constant power to give positive spreading control. Heavier steel framework and flared sideboards improve load capacity and ease of loading.

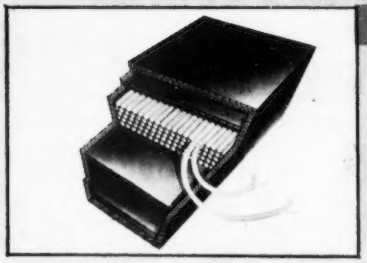
DURKEE ATWOOD V-BELTS

EXTRA VALUES
FOR USERS OF INDUSTRIAL V-BELTS



VERTICAL MATCHING ASSURES EQUAL POWER TRANSMISSION

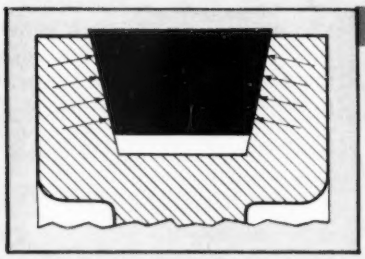
Durkee-Atwood's new vertical V-belt matching machines eliminate the "sag" error always present when V-belts are matched on horizontal matching equipment. Calibration of true running length assures equal power transmission from all belts on multiple belt drives. The machines also test for vibration and possible internal imperfections.



DU PONT CORDURA® RAYON MULTIPLE CORD CONSTRUCTION

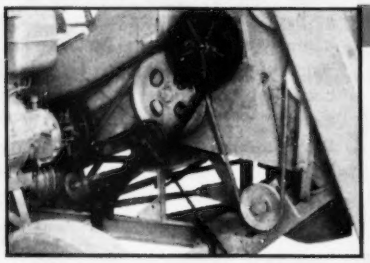
High-tenacity Cordura® rayon cords give Durkee-Atwood Industrial V-Belts longer life, less stretch, and greater shock resistance. Use of this revolutionary new cord material is another one of the reasons why D-A Industrial V-Belts are guaranteed to satisfy on any drive.

®Trademark E. I. Du Pont De Nemours & Co., Wilmington, Del.



STRAIGHT SIDEWALLS—FULL GROOVE CONTACT

Durkee-Atwood V-Belts are manufactured with straight sidewalls to maintain full groove contact at all times giving positive drive action. Straight sidewalls reduce slippage and assure smooth, efficient power transmission. The load is distributed evenly over the entire thickness of the belt giving it longer life.



FIELD-TESTED AND APPROVED

Durkee-Atwood V-Belts are delivering the power for more and more manufacturers of agricultural equipment. Durkee-Atwood attention to details both in adherence to specific engineering standards and to specific delivery requirements makes Durkee-Atwood your best possible source for your V-belt requirements.

New Warehouse Stocks • Chicago, Atlanta, Cleveland, Jersey City

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DA PRODUCTS

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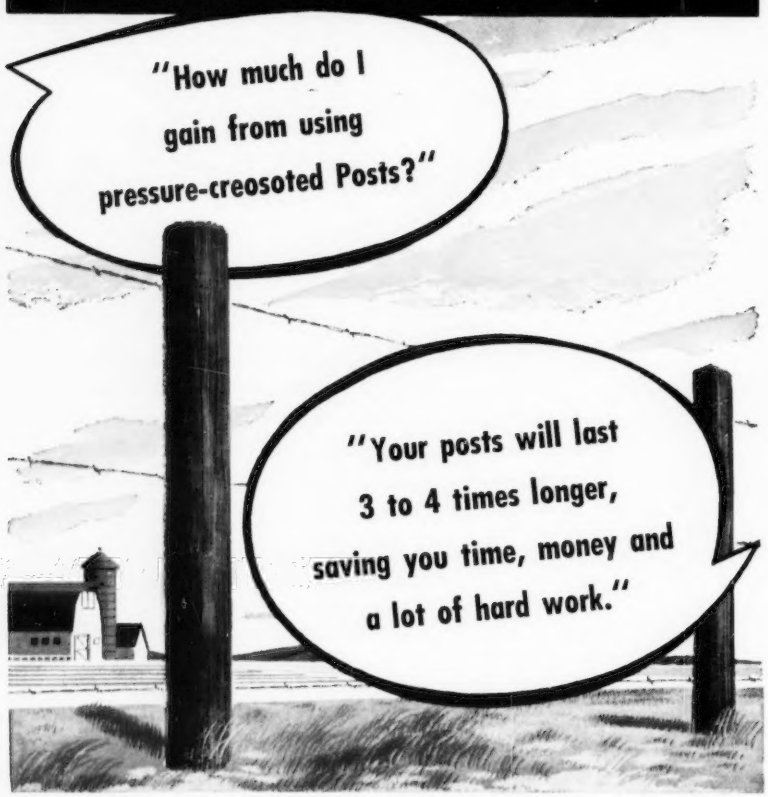
A FARMER ASKS...


"How much do I gain from using pressure-creosoted Posts?"
"Your posts will last 3 to 4 times longer, saving you time, money and a lot of hard work."

FARMERS report that wood posts stay sound and usable for 30 and even 40 years when they are pressure-treated with creosote. Pressure-creosoting *completely* protects the wood from insects and fungi that cause decay. It makes the wood more resistant to burning . . . reduces the likelihood of a grass fire destroying a fence.

You're doing right by the farmers in your district if you always recommend pressure-creosoted fence posts. Remember . . . creosote is the *only* preservative that keeps wood sound and serviceable under severe conditions for more than 30 years!

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KOPPERS

All Standard Specifications

Creosote

The Performance-Proved Wood Preservative

Farm Housing and Storage Structures

(Continued from page 36)

Silos are a rather new type of storage having been developed mainly during the last 50 years. The early silos were mostly built of wood staves. The staves were held in place by steel hoops or bands placed horizontally around the silo, the size and spacing of the hoops being governed by the diameter and height of the silo. Early in the 1900's the more permanent types of silos were developed. They were constructed of cast-in-place concrete, concrete block, concrete staves, ceramic staves, steel and structural clay tile. Of more recent origin is the glass-lined steel silo. All of these types are being constructed today.

The upright type of silo seems destined to continue in use for many years to come. It is impressive in appearance, serves its purpose well and is being vigorously promoted by the builders specializing in that field of endeavor. Field cutters have reduced appreciably the labor of filling silos. Various equipment is being perfected for taking silage out of the silo at feeding time.

The trench silo is a development from the pit type of silo of earlier years. It consists of a long trench-like structure excavated in the earth. The trench silo can be built to any required size and capacity and when walls are lined with concrete it is an enduring structure. Not all locations are suitable to the construction of trench silos. The site on which they are built should be well drained to avoid entrance of ground water.

CONCLUSIONS

In reviewing the progress that has been made in farm housing and in farm storage structures during the past century, one significant fact stands out, namely, that much of this progress has been due to the application of engineering. The modern farm home and the modern farm storage building are largely the product of engineering skills and applications. Many kinds of engineering have contributed to this progress—structural engineering, civil engineering, architectural engineering, chemical engineering, mechanical engineering, sanitary engineering, agricultural engineering, and other forms of engineering. The agricultural engineer's special part in this advancement of science and production has been to apply the various engineering skills in such manner that the special needs of agriculture will be best served.

A report to you about men and machines that help maintain International Harvester leadership

Plow Chief bottoms with Spear-Head points help this farmer to maintain uniform plowing depth in tough, root-bound sod.

IH Engineers developed Plow Chief bottoms to do better plowing at lower cost

The Problem

Thousands of blacksmith shops disappeared with the decline of horse farming. This made it inconvenient and expensive to keep plow shares properly sharpened. As a result, many farmers put up with hard-pulling, dull shares that wasted their time, boosted their costs and spoiled their plowing job.

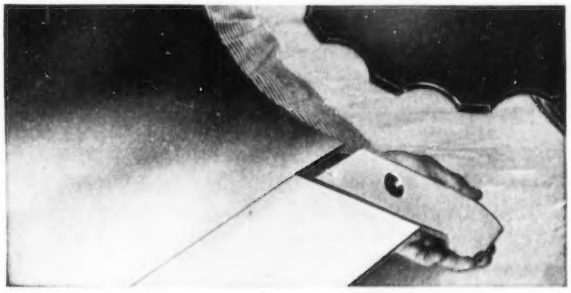
The Solution

IH engineers experimented with low-cost, disposable share blades. They soon decided that the point was just as critical a factor in share life and bottom performance as the blade. As a result, they developed an entirely new bottom to meet five different requirements:

Eliminate share sharpening and repointing.
Reduce share cost and maintenance expense.
Do good work at all tractor plowing speeds.
Penetrate and maintain uniform depth in hard soils.
Scour well in all types of soil.

The Benefits

Today, the McCormick Plow Chief bottom with *replaceable Spear-Head point* has greatly reduced plowing costs. But this is only half the story. This new bottom does good work in wider range of soils than *any other* plow bottom!



Fast, two-bolt attachment makes it easy to replace Spear-Head points. A new point restores original suction to a Plow Chief bottom at about the cost of sharpening a conventional share. A Spear-Head point lasts twice as long as an ordinary share point.

IH engineering teamwork produced the McCormick Plow Chief bottom with replaceable Spear-Head point. Today, IH research, engineering and manufacturing men are pooling their time and talents to solve other farming problems. Their goal, as always, is to provide equipment that makes farm work easier and the farmers' time more productive!

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International Harvester products pay for themselves in use—McCormick Farm Equipment and Farmall Tractors . . . Motor Trucks . . . Crawler Tractors and Power Units . . . Refrigerators and Freezers—General Office, Chicago 1, Ill.

$700 saved...

more efficiency gained

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courtesy IOWA MFG. CO.

That's the experience of the IOWA MFG. CO., manufacturers of this super-tandem crushing plant which employs a 1¼" STOW power drive shaft, operating at 800 RPM. A centrifugal clutch relieves sudden starting loads. Use of the flexible shaft as shown permits a swing of up to 90 degrees either side of the center line.

This is another fine example proving the efficiency, the practicability of STOW flexible shafting.

Why not consult with STOW engineers on your next power transmission problem. You'll find that Stow flexible shafting can really do a job for you!

***Write today** for this free bulletin 525 and Torque Calculator, containing complete data on STOW flexible shafting. No obligation, of course.*

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Applicants for Membership

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

AMER, AHMAD—Asphalt plant inspector, Alaska Road Commission, USDI, Valdez, Alaska

ANDERSEN, FRANCIS A.—Junior engineer, New Idea Division, Avco Mfg. Corp. (Mail) General Delivery, St. Henry, Ohio

ARNDT, RAYMOND—General manager, Habco Mfg. Co., Columbus, Nebr. (Mail) P O Box 464

BANKS, G. A.—Extension service, New Brunswick Department of Agriculture. (Mail) 11 Oak St., Moncton, N. B., Canada

BARNES, LEROY E.—Project engineer, The Oliver Corp., Shelbyville, Ill.

BEARDSLEE, ROBERT—Junior engineer, Dearborn Motors Corp., Birmingham, Mich. (Mail) 1533 Penastone

BEEBE, JAMES R.—Research assistant and graduate student, division of agricultural engineering, University of Minnesota. (Mail) Trempealeau, Wis.

BICHEL, DARWIN C.—Instructor in agricultural engineering, Iowa State College, Ames, Iowa. (Mail) 196 Pammel Court

BIRD, D. R.—Construction engineer, Royal Canadian Air Force. (Mail) 2017-26 A St., S. W., Calgary, Alta., Canada

BLACK, C. D.—Assistant sales manager, Alabama Steel Buildings Co., Montgomery, Ala. (Mail) 752 S. Court St.

BLACK, RICHARD D.—Graduate student, University of Illinois, Urbana, Ill. (Mail) 1425 Maryland Dr.

BOESCH, JOHN C., JR.—Chief engineer, Lilliston Implement Co., Albany, Ga.

BREED, ARIE E.—Design engineer, John Deere Ottumwa Works, Ottumwa, Iowa

BRENNER, LOUIS C., JR.—1807½C 18th Ave. N., St. Petersburg 2, Fla.

CAHN, ALLEN M.—Junior engineer, general plant eng. dept., Johns-Manville Corp. (Mail) 37 A Hawthorne Dr., New Brunswick, N. J.

CLARK, WILLIAM T.—Design engineer, The Oliver Corp., South Bend, Ind. (Mail) 411 Dundee

CONDON, EDWARD J.—Design superintendent, Hawaiian Commercial & Sugar Co., Ltd., Puunene, Maui, T. H. (Mail) P O Box 372

CRAIG, KENNETH R.—Civil engineer, Court House, Swift Current, Sask., Canada

DAHLIN, WARREN Q.—Hydraulic engineer, U. S. Geological Survey, USDI, Box 586, Kalispell, Mont.

DALTON, JAMES A.—Field service trainee, Caterpillar Tractor Co. (Mail) Greenfield, Ill.

DAVIS, CHARLES W.—Service supervisor, Florida Ford Tractor Co., P O Box 1258, Jacksonville, Fla.

DAVIS, J. I., JR.—Secretary-treasurer and general manager, Southeastern Liquid Fertilizer Co., Albany, Ga. (Mail) Box 1147

FULGHAM, FLOYD E.—Junior agricultural engineer, Delta Branch Experiment Station, Stoneville, Miss.

GIESEKE, LOUIS F.—Student, University of Minnesota. (Mail) Janesville, Minn.

GIPP, WILBERT O.—Junior engineer, New Idea Division, Avco Mfg. Corp., Coldwater, Ohio. (Mail) 320 W. Main St.

GRALAK, STANLEY D.—Supervisor, stress analysis div., materials engineering dept., Deere & Co., Moline, Ill.

GROSSE, KENNETH D.—Student, University of Minnesota. (Mail) R R 3, Red Wing, Minn.

HAMILTON, LLOYD L.—Manager, agricultural div., Minneapolis-Honeywell Regulator Co., 2753 4th Ave. S., Minneapolis 8, Minn.

HANCOCK, THOMAS E.—Education manager, Florida Ford Tractor Co., P. O. Box 1258, Jacksonville, Fla.

HARCHENKO, CLIFFORD—Farmer, Larslan, Mont.

HEINLEIN, JOHN L.—Chief engineer, The Oliver Corp., Shelbyville, Ill. (Mail) 814 N. Will St.

HENRY, R. W., SR.—Sales manager, John Deere Dubuque Tractor Works. (Mail) 8504 W. 63rd St., Merriam, Kans.

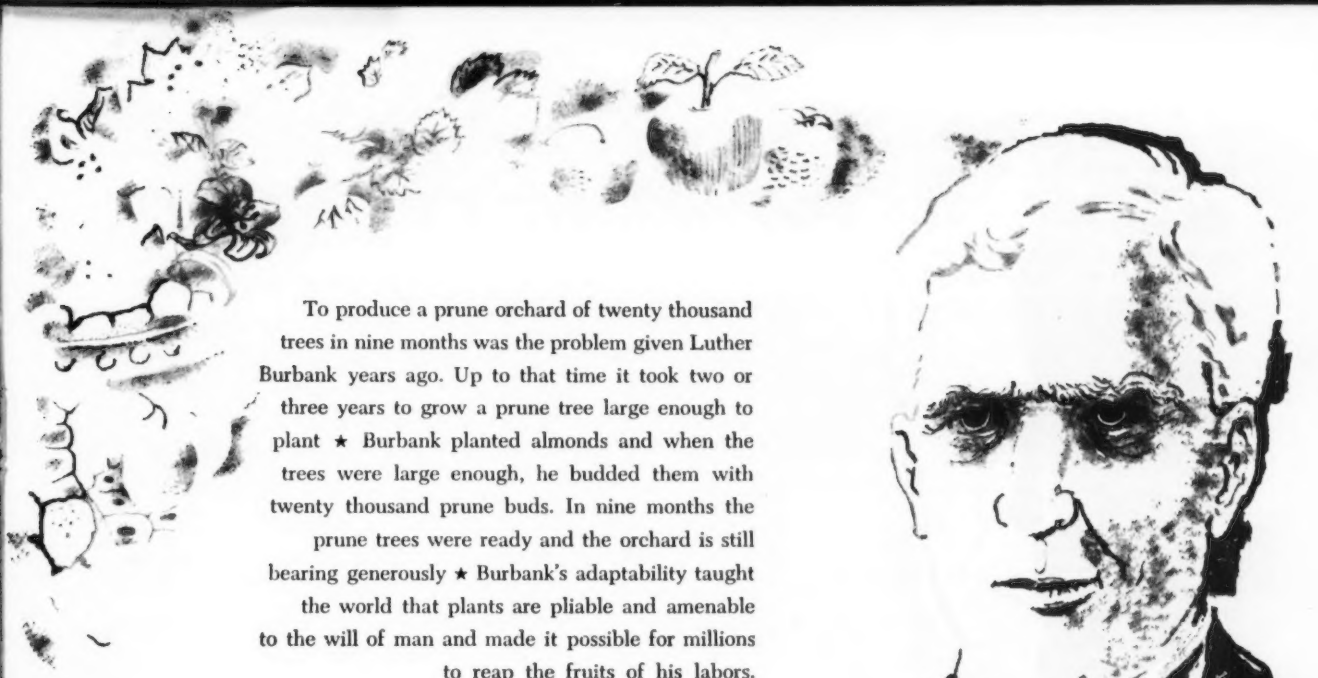
HENSON, WILEY H., JR.—2nd. Lt., supply and motor officer, U. S. Army, 509 Engineer Combat Co. (Mail) R R 1, Ellijay, Ga.

HOLMEN, HAROLD — Construction engineer, Bureau of Reclamation (USDI). (Mail) 811 Sixth St., Brookings, S. D.

HOOVER, MARTIN E.—Engineering trainee, The Oliver Corp. (Mail) R R 3, Goshen, Ind.

HUSSAIN, P. M.—Student, University of Wisconsin, Madison. (Mail) 814 W. Dayton St.

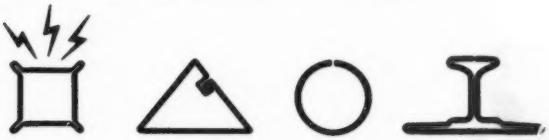
(Continued on page 50)



To produce a prune orchard of twenty thousand trees in nine months was the problem given Luther Burbank years ago. Up to that time it took two or three years to grow a prune tree large enough to plant ★ Burbank planted almonds and when the trees were large enough, he budded them with twenty thousand prune buds. In nine months the prune trees were ready and the orchard is still bearing generously ★ Burbank's adaptability taught the world that plants are pliable and amenable to the will of man and made it possible for millions to reap the fruits of his labors.

adaptability

It may be a far cry from vegetables to Van Huffel, but farm equipment manufacturers will tell you they are both basic in the scheme of things ★ For instance, where deadweight must be cut from a tractor without sacrificing strength . . . where a farm implement must be easier to carry, move or lift without complicated fabrication . . . a lot of production problems are being solved by the adaptability of Van Huffel Metal Shapes and Tubing.



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Applicants for Membership

(Continued from page 48)

HUTCHESON, RUTH—Home management specialist, Purdue University Extension Service, West Lafayette, Ind. (Mail) Station Annex

IVERSON, MYRON J.—Farm manager, Iverlee Farms. (Mail) 421 Ash, Ames, Iowa

JOHNSON, CHARLES THOMAS—Student, University of Florida, Gainesville. (Mail) Kappa Alpha House

JOHNSON, GLEN W.—Trainee, tractor div., Minneapolis-Moline Co., Minneapolis, Minn. (Mail) 2220-27 Ave. S.

JORDAN, KENNETH A.—Damage control officer assistant, engineering dept., U. S. Navy. (Mail) USS Edisto AGB-2 Fleet Post Office, New York City, N. Y.

KAMINSKY, DAVID—Draftee, U. S. Armed Forces. (Mail) 12157 Perry Ave., Chicago 28, Ill.

KENNA, FENTON L., JR.—Graduate research assistant, Louisiana Agricultural Experiment Station, Baton Rouge, La. (Mail) Box 5529

KERCHEVAL, RONALD LYNN—Partner of Lazy K Ranch, Chelan, Wash. (Mail) Box 545

KLINGE, ALBERT F.—Instructor in agricultural engineering, Purdue University, West Lafayette, Ind. (Mail) 440 N. Salisbury St.

KNOX, ARNOLD WILLIAM—Rural electrification adviser, East Central Oklahoma Electric Coop., 408-10 W. Sixth St., Okmulgee, Okla.

KORPELA, WALTER G.—Farmer, Box 36, Star Route, Columbus, Mont.

LANE, DELBERT E.—Student engineer, New Idea Division, Avco Mfg. Corp. (Mail) 553 E. Livingston, Celina, Ohio

LAY, CLARENCE W.—Field service representative, New Holland Machine Co. (Mail) Box 127, West Union, S. C.

LINN, ANDREW—Agricultural engineer (SCS), USDA. (Mail) Box L, Adrian, Wash.

LOPER, WILLARD H.—Student, Cornell University. (Mail) R R 2, Freeville, N. Y.

LOVINGOOD, ALTON J.—2nd Lt., U.S. Army. (Mail) RR 1, Kennesaw, Ga.

MCKNIGHT, L. JAMES—Product educator, Hub Motor Sales, Inc. (Mail) R R 3, Rockville, Conn.

MACKAY, DONALD R.—Research fellow, agricultural engineering dept., Rutgers University, New Brunswick, N. J.

MAYES, HERMAN F.—Agricultural engineer, USDA. (Mail) Agricultural Engineering Bldg., Purdue University, West Lafayette, Ind.

MILLER, ROGER A.—Student, South Dakota State College, Brookings. (Mail) Box 785, State College Station

MITCHELL, NOLAN K.—Rural power use advisor, Huntington County REMC, Huntington, Ind. (Mail) R R 7

MUEHLHAUSEN, CHARLES H.—Project engineer, The Oliver Corp., Shelbyville, Ill. (Mail) R R 2

NEUMAN, THEODORE R.—Hydraulic engineer, Bureau of Reclamation (USDI). (Mail) Box 626, Bozeman, Mont.

NEWBURY, GEORGE H.—Student, University of Florida, Gainesville. (Mail) R R 3, Box 199

NUTTER, JAMES M.—Assistant agricultural engineer, Hawaii Sugar Planters Experiment Station, 1527 Keeaumoku St., Honolulu, Hawaii

OLSON, KERN C.—Farm structures representative, Weyerhaeuser Sales Co., First National Bank Bldg., St. Paul 1, Minn.

PALMER, DAVID B.—2nd Lt., Army Motor Transport Div., Transportation Research & Development Station. (Mail) Pataskala, Ohio

PARIS, ROBERT A.—Student, U.S. Air Force. (Mail) Dighton, Kans.

RICHARDS, JAMES R.—Trainee, New Idea Division, Avco Mfg. Corp. (Mail) 407 N. Vine St., St. Marys, Ohio

ROOKE, JAMES F.—Research engineer, mechanical div., Ministry of Agriculture, Khartoum, A. E. Sudan. (Mail) Tozi Research Farm, Wad el Nail, Singa Dist.

SANDEMAN, ERIC M. E.—Farm manager, C. W. S. Elton Estate, Cowley, Alta., Canada

SEBERN, JAMES R.—Design engineer, The Oliver Corp, Shelbyville, Ill. (Mail) 312 N. Spruce St.

SEDREL, DONALD MAX—2nd Lt., U. S. Army Corps of Engineers. (Mail) Hamilton, Iowa

SHOVE, GENE C.—Graduate research assistant in agricultural engineering, Kansas State College, Manhattan. (Mail) 1723 Leavenworth

SINK, PAUL G.—Product tester, International Harvester Co. (Mail) 410 S. Merrill St., Fortville, Ind.

SMITH, GEORGE B.—Agricultural development agent, Carolina Power & Light Co., Asheville, N. C. (Mail) Box 2935

SMITH, WILLIAM R.—Soil conservationist (SCS), USDA, Room 302, Court House, Valparaiso, Ind. *(Continued on page 52)*

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LINK-BELT conveyor screws and components are engineered to give you the right screw conveyor for your particular needs

THERE are many important factors in conveyor screw construction that must be correlated to give you top screw conveyor efficiency. That's why Link-Belt's "total engineering" is so vital to you . . . why Link-Belt conveyor screws are first choice of so many leading designers.

Consider Link-Belt's broad experience in building conveyor screws for every type of farm machinery. And, remember, Link-Belt makes all types and sizes of components—can give you the ones that exactly match your requirements.

For any auger or screw conveyor applications on your farm machinery, call the Link-Belt office near you for complete information.

The complete auger, for gathering cut grain back of the sickle bar, is furnished by Link-Belt for this new McCormick 127-SP harvester-thresher.

LINK-BELT builds augers and screw conveyors for many farm machines.

Combines

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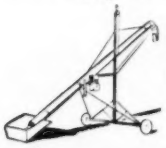
Forage harvesters



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Forage blowers

Post hole diggers

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Applicants for Membership

(Continued from page 50)

SPICACCI, A. R.—Vice-president, Bearings Co. of America, Lancaster, Pa.

STARR, CHARLES G.—Template layout man, North American Aviation, Inc. (Mail) Litchfield, Ohio.

STEIGER, HENRY A.—Farm manager, Delavan, Ill.

THOMAS, JOHN A., JR.—Parts representative, International Harvester Co., 931 N. 24th St., Birmingham, Ala.

TOVEY, TERREL R.—Conservation engineer, Bureau of Indian Affairs, USDI, Fort Hall Indian Agency, Fort Hall, Idaho

VIRTUE, J. D.—1004 15th, Onawa, Iowa

VOLLMER, ROBERT C.—Farmer, 3 Pine Court, Washington, Ind.

WAGNER, HILLARD J.—Industrial field engineer, Warner Electric Brace & Clutch Co., Beloit, Wis.

WALKER, RICHARD P.—Sales and design engineer, Dunham-Wilson Mfg. Co. (Mail) RFD Box 202, Elton, La.

WEBB, ROBERT D.—Student, Michigan State College. (Mail) 2176 Hamilton Rd., Okemos, Mich.

WEBB, STUART M.—Specifications engineer, Blood Bros. Machine Co., Allegan, Mich.

WESTERGARD, KENNETH D. — Student, Iowa State College. (Mail) Graettinger, Iowa

WICK, RICHARD R.—Full partner of dairy farm, Merwick Farm, R R 5, West Chester, Pa.

WOOD, WARREN A.—Service engineer, Rilco Laminated Products, Inc. (Mail) P O Box 106, Fowlerville, Mich.

WOODBURN, SAMUEL L.—Farmer, Hillsdale, Ill.

YORK, ROBERT L.—Sales engineer, agricultural div., Hartzell Propeller Fan Co., Piqua, Ohio

YOUNG, ROBERT G.—Trainee, New Holland Machine Co., The Sperry Corp. (Mail) R R 3, Villa Rd., Springfield, Ohio

ZWERMAN, PAUL J.—Associate professor of soil conservation, department of agronomy, Cornell University, Ithaca, N. Y.

TRANSFER OF MEMBERSHIP GRADE

SWANSON, RANDALL C.—Associate professor of agricultural engineering University of Wisconsin, Madison, Wis. (Affiliate to Member)

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. . . to Fit the Job
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HEAVY-DUTY
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Model 2E Case elevator, powered by Model AKN single cylinder engine.
A Model TF 2-cylinder engine provides ideal balance and power for the Ariens tiller.
This Minneapolis Moline "Harvester 69" combine is powered by a 4-cyl. engine.
Wisconsin Engines fit the machine because they pack a lot of power in a small package. Extremely compact, light in weight . . . they can be mounted on almost any equipment without costly re-designing of the machine.
Wisconsin Engines fit the job, even under the severest operating conditions, because they are of heavy-duty design and construction throughout. Timken tapered roller bearings at both ends of the crankshaft carry the load and prevent bearing failure, assuring a smooth-running engine and low maintenance cost.
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These are some of the reasons why it pays manufacturers of farm equipment to specify Wisconsin Heavy-Duty Air-Cooled for their machines. Reasons, too, why it pays the user to specify "Wisconsin Engine Power". These engines have been pre-judged and pre-selected by more power-wise purchasers than ALL other makes of engines combined within a 3 to 36 hp. range. Descriptive and engineering data gladly supplied on request.
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Agricultural Engineering History at the University of Illinois

EDITOR'S NOTE: Information prepared by the agricultural department, University of Illinois, for the Engineers' Council for Professional Development, includes historical notes on the development of agricultural engineering at that institution, which are of general interest as indications of early thought and work in this field by leaders in both engineering and agriculture and are here recorded as a contribution to the history of agricultural engineering.

THE founders of the University recognized the need for the solution of problems and the advancement of knowledge in the various lines of work now generally recognized as phases of agricultural engineering. The problems of drainage and land development, the need for more adequate buildings, the development of machines and power units prompted the appointment of staff or the assignment of teaching duties in these fields to various staff members.

In 1868 the University was opened with six departments, one of which was the "department of agriculture." At that time two courses in agriculture were offered. In the course in "general agriculture," rural engineering and architecture were listed as topics for discussion. In the course outline, fences, farm buildings, surveying, mapping, the structures and use of farm implements, and road making were given a prominent place. A position of professor of civil engineering and agricultural engineering was established in 1869, and was filled in 1870 when Col. S. W. Shattuck was made professor of civil engineering, instructor in mathematics, and professor of agricultural engineering. Further interest is evidenced by the fact that in the 1870-71 annual catalog, in addition to Colonel Shattuck, S. W. Robinson was listed as professor of agricultural machinery in addition to his duties as professor of mechanical engineering and physics. In 1873, N. W. Ricker taught a course in rural architecture, and at about the same time the superintendent of agricultural experiments, W. C. Flagg, taught buildings and machinery as a part of the general agriculture course.

Emphasis on engineering was revived by George Morrow, who taught agricultural engineering in 1890-92. At the same time J. W. White, later University supervising architect, taught a course in agricultural drawing. Four years later, in 1896, P. G. Holden taught machinery, buildings, and drainage in one course. In 1898, J. W. White, assistant professor McLane, and a professor Ricker jointly gave a course in domestic architecture.

(Continued on page 54)

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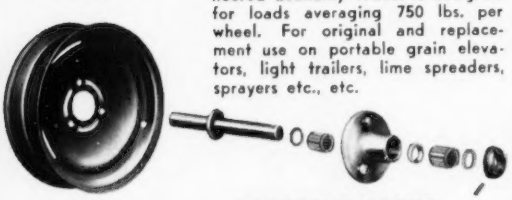

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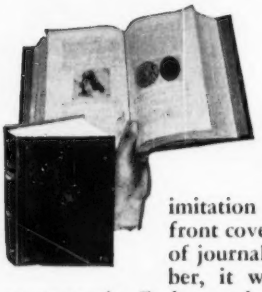

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A-E History at the University of Illinois

(Continued from page 52)

In 1895 Dr. Eugene Davenport, then professor of agriculture and head of the department, organized four departments which formed the College of Agriculture. The subject matter of rural architecture, machinery, and drainage was assigned to the Department of Agronomy as a Division of Farm Mechanics. F. R. Crane was put in charge, under Dr. Cyril Hopkins. Five courses were offered: Drainage and irrigation; field machinery; farm power machinery; farm buildings, fences, and roads; and special work in farm mechanics.

In June, 1905, Dean Davenport secured an appropriation for a farm mechanics building. As a result, the present agricultural engineering building of temporary fire-resisting construction was built for $32,596 and occupied in 1906.

With the new building there came an increased interest, with a staff addition. The 1907-08 Trustee's report shows the addition of E. A. White. In 1909 I. W. Dickerson was appointed to teach machinery and K. J. T. Ekblaw to teach farm buildings. The following year C. O. Reed was added to teach power and machinery and M. E. Jahr to teach drainage and surveying. In 1915 C. R. Newell was appointed and in 1916 his place was taken by an assistant, R. I. Shawl, who has been on staff continuously since then except while in the navy during World War I.

To the late Dean Eugene Davenport belongs the credit for the advancement made in agricultural engineering during the approximately 30 years he served as dean of the college, including the organization of a division of farm mechanics; the construction of a building for the division; and approval of the formation of a separate department of farm mechanics, the name of which was changed to agricultural engineering in 1932. At this time a curriculum in agricultural engineering was established in the College of Engineering.

Borrowing for Profit

(Continued from page 15)

Continued high land prices, and growing competition of farm youth for the life of the modern farmer may bring about renewed interest in borrowing for non-real estate investment to increase profit possibilities. One point, however, is strongly indicated by the survey. There is a definite resistance among many farmers to mortgaging their homes and going enterprises for the prospect of increasing their returns by increasing their investment and intensity of operations on their present lands. The market for new equipment, new ideas, and new practices to increase farm earnings will be improved when more lenders will share more of the risk associated with the "highly probable returns."

Personnel Service Bulletin

The American Society of Agricultural Engineers conducts a Personnel Service at its headquarters office in St. Joseph, Michigan, as a clearing house (not a placement bureau) for putting agricultural engineers seeking employment or change of employment in touch with possible employers of their services, and vice versa. The service is rendered without charge, and information on how to use it will be furnished by the Society. The Society does not investigate or guarantee the representations made by parties listed. This bulletin contains the active listing of "Positions Open" and "Positions Wanted" on file at the Society's office, and information on each in the form of separate mimeographed sheets, may be had on request. "Agricultural Engineer" as used in these listings, is not intended to imply any specific level of proficiency, or registration, or license as a professional engineer.

NOTE: In this bulletin the following listings still current and previously reported are not repeated in detail; for further information see the issue of AGRICULTURAL ENGINEERING indicated.

POSITIONS OPEN — 1952 — SEPTEMBER — O-741-581. OCTOBER — O-767-583, 767-584, 782-589, 783-590, 785-591, 774-595. NOVEMBER — O-824-596. DECEMBER — O-797-597, 875-598, 876-599.

POSITIONS WANTED — 1952 — AUGUST — W-693-131. SEPTEMBER — W-735-133, 739-134. OCTOBER — W-769-137. NOVEMBER — W-793-141, 791-142, 823-144, 810-145. DECEMBER — W-843-146, 814-147, 832-148, 849-149, 866-150, 860-151.

NEW POSITIONS OPEN

INSTRUCTOR to teach service courses in farm electric applications for 2-yr students in agriculture, at an eastern land grant university. Qualified man might also have opportunity to teach in soil and water field. BS deg in agricultural engineering. Farm background. Teaching ability and good appearance before a group. Future opportunity depends on ability and application. Age 22-27. Salary $3720 for school year. Possible additional summer work and pay. O-869-600

(Continued on page 56)

NEW IDEA MOWERS

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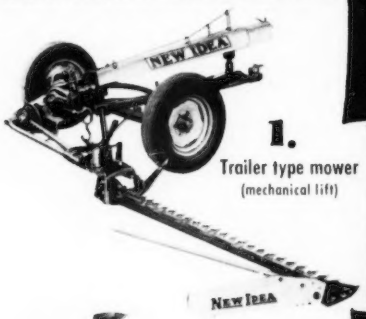

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RATES: Announcements under the heading "Professional Directory" in AGRICULTURAL ENGINEERING will be inserted at the flat rate of $1.00 per line per issue; 50 cents per line to ASAE members. Minimum charge, four-line basis. Uniform style setup. Copy must be received by first of month of publication.

Personnel Service Bulletin

(Continued from page 54)

AGRICULTURAL ENGINEER for teaching and extension in an eastern land grant university. BS and MS deg in agricultural engineering or equivalent. Farm background. Teaching and or extension experience enough to take charge and develop the work. Usual personal qualifications for teaching and extension. Facilities in part of new building designed for instruction in agricultural engineering. Opportunity for advancement excellent. Need for additional work in this field is recognized. Salary open. O-842-601

INSTRUCTOR to teach courses in irrigation, hydrology, erosion control, irrigation engineering, and some farm machinery in a western college. BS deg in agricultural engineering, MS deg or PhD preferred. Farm background and some college teaching or work experience in soil conservation, irrigation or related engineering. Good personality, interest in teaching, ability to cooperate and get along well with others, initiative and imagination to develop an outstanding program. Emphasis in the teaching at this college is on practical application, using the 3000-acre college farm as a laboratory. Opening effective March 15. Age 25-40. Salary $3,720 to $6,360, depending on qualifications, for academic year of 3 quarters. Additional for summer school teaching when required. O-891-602

AGRICULTURAL ENGINEER for teaching and research in farm machinery and soil and water, or rural electrification in an eastern land grant university. BS deg in agricultural engineering or equivalent required. MS deg preferred. Farm background, teaching or industrial experience, and ability to get along with people. Opportunity up to individual. Age, under 40. Salary open, $3300 min. O-894-603

AGRICULTURAL ENGINEERS (2) for repair and maintenance, development, and supervision of crop production, harvesting and handling equipment for a large farm product processing organization in the north central region. BS deg in agricultural engineering, or equivalent, with 1-4 yrs experience. Good supervisor with ability to organize and carry projects to completion. Good opportunity for advancement. Age 24-32. Salaries $4000-4400 and 4800-5200 ranges. O-892-604

NEW POSITIONS WANTED

DESIGN, development, research, or teaching in power and machinery or rural electric field, with industry or public service in Southwest. BS deg 1950. MS deg 1952. Farm background. College teaching experience 2½ yr. War service in Navy 2 yr. Married. Age 26. No disability. Available on reasonable notice. Salary open. W-827-152

EXTENSION, teaching, research, sales, or service in farm structures field with industry or public service. Any location. BS and MS deg 1951-53, University of Missouri. War enlisted service 1½ yr. Meteorological aide, Weather Bureau, 1 yr. Electrification advisor, REA Coop, 7 mo. Assistant instructor while working on MS deg. Married. Age 28. No disability. Available February 1. Salary open. W-872-153

DESIGN, development, research, or management in farm structures field, especially greenhouses or storage structures, with manufacturer, consultant, or federal agency. Any location. BS deg in agriculture, major in agricultural engineering. War non-commissioned service in Air Corps, 6 yr, including duty as crew chief and line chief. Tool maker 2 yr. Tool standards and process engineer 2 yr. Married. Age 35. No disability. Available in February. Salary open. W-884-154

TEACHING, research, sales, service, writing, or management, in farm structures, rural electric, soil and water or product processing field, with manufacturer or public service. Any location. Willing to travel part time. BS deg in agricultural engineering 1943, University of Georgia. War enlisted service in Air Force nearly 3 yr. Manufacturer's representative 15 mo. Farm shop instructor one year. Farm representative with electric utility 3½ yr. Self-employed as reinforced concrete grain bin contractor nearly 1 yr. Married. Age 31. No disability. Available now. Salary open. W-880-155

SALES, service, writing, or management in power and machinery or rural electric field with manufacturer, processor, distributor, consultant, farming operation, or trade association, east of the Mississippi River. Willing to travel part time. BS deg in agricultural engineering 1941, Virginia Polytechnic Institute. Soil Conservation Service 7 mo. War and postwar commissioned service in Army Artillery, 5 yr, with promotions to Major. Farm coop service store manager 2 yr. R E A, 13 mo. Extension agricultural engineer 1½ yr. Married. Age 31. No disability. Available now. Salary open. W-886-156

TEACHING or research in power and machinery, farm structures, soil and water, or methods engineering with college or experiment station. Any location except deep South. BA deg in natural sciences 1947, Cambridge University. Research assistant candidate for PhD, March, 1953, Cornell University. War commissioned service 6 yr as military technical officer. Research assistant various periods, British National Institute of Agricultural Engineering, Swedish Institute for Agricultural Engineering, Utah State Agricultural College, and Cornell University. Assistant in teaching at Cambridge University. Married. Age 31. Amputation of left hand due to war service injury. Available July 1. Salary $5000. W-896-157

SALES, service, promotion, or development in power and machinery or soil and water field with distributor, consultant, manufacturer, processor, or trade association in Midwest. BS deg in agricultural engineering, 1950 Purdue University. Farm background. Experience 6 months with large water supply development organization. Army service 2 yr. Noncommissioned, Army Corps of Engineers School, teaching mathematics, electricity and electronics. Single. Age 24. No disability. Available February 5. Salary $5000. W-899-158

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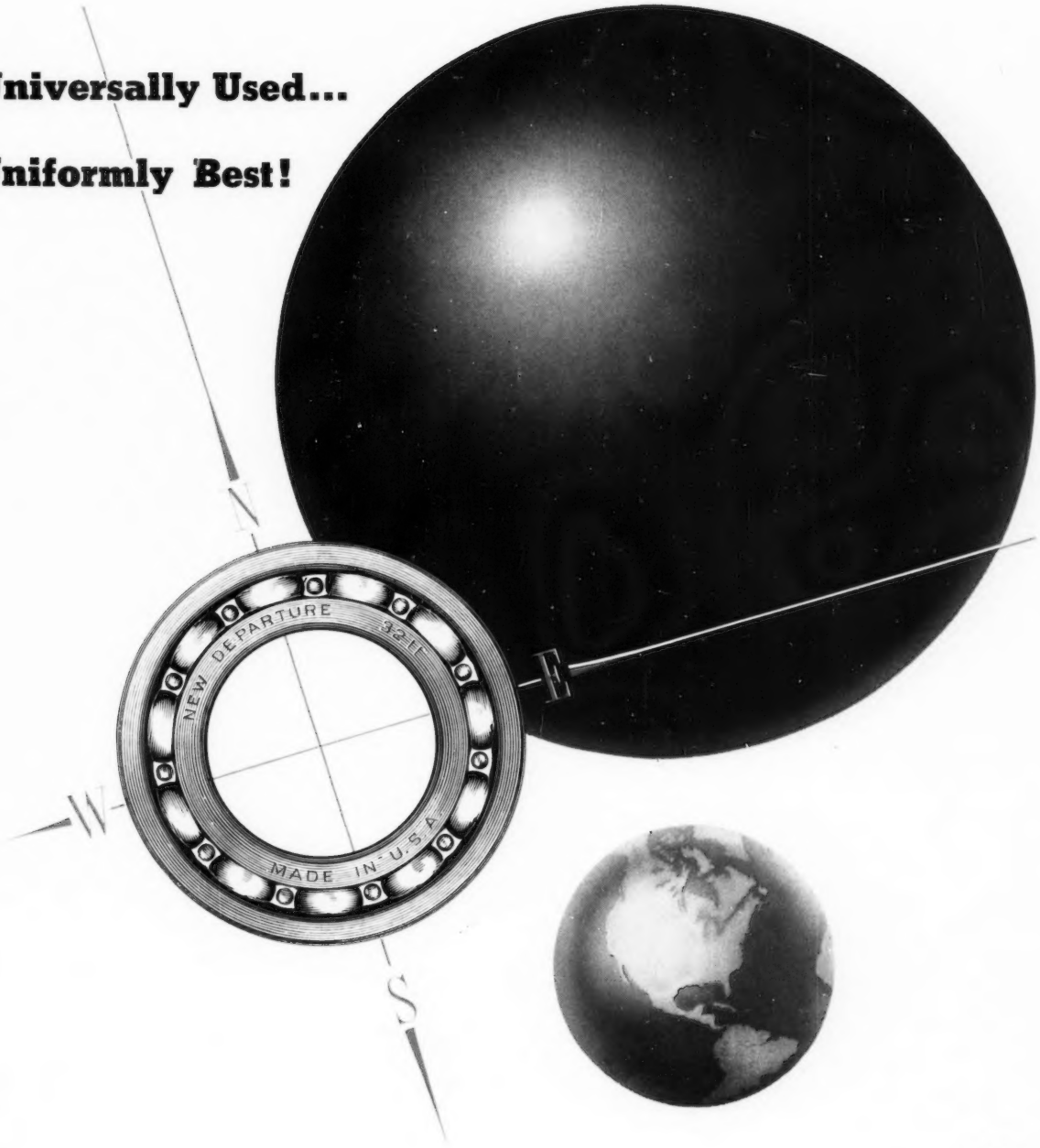

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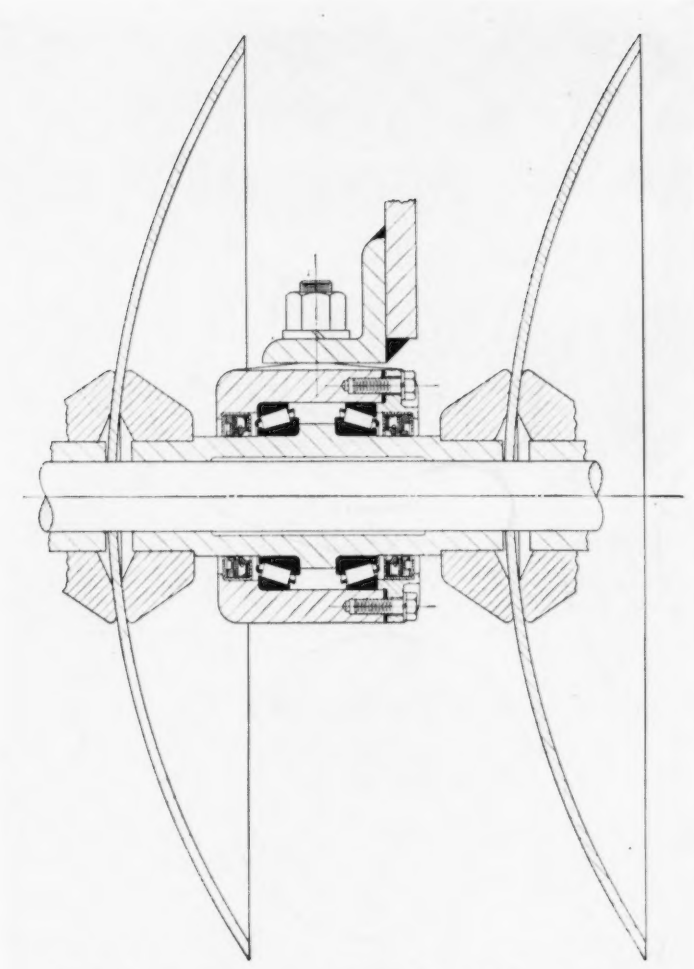

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